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**New rail motor coach with 300-H.P. Diesel motor,
mechanical transmission, radial axles, type A2A, in
service in Switzerland,**

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At the beginning of this year a new type of Diesel rail motor coach was put into service in Switzerland for use on non-electrified secondary lines, to take the place of steam trains which are not economical for this class of service, especially in view of the very high proportion of dead weight per unit of useful weight to be carried.

This rail motor coach, which is illustrated in figures 1 and 2, has certain new features which we think will interest those engaged in traction; we give below a general description of it. The rail motor coach is of the A 2 A type ⁽¹⁾, the two end pairs of wheels being driven by mechanical transmission from a Diesel motor carried on an independent truck supported by two middle pairs of carrying wheels which form the rigid

wheel base of 3 850 mm. (12 ft. 7 ³/₁₆ in.). In consequence of this arrangement the body of the coach is only carried on its four corners by the springs arranged on each end of the driving trucks, and the noise and vibrations of the motor are very well isolated from the body, i. e. from the passenger compartments (see figs. 2 and 3).

The connection between the driving axle trucks (which alone carry the body as we have just said) and the truck carrying the motor is carried out by means of two spherical pivots indicated by A on figures 2 and 4, about which the trucks pivot at a radius of 3 250 mm. (10 ft. 8 in.). The driving axles consequently on a curve take up practically a radial position (see fig. 4), thereby largely improving the good running qualities ⁽²⁾ and lessening the wear of the flanges and

⁽¹⁾ This type (2-4-2) is also designated sometimes by A-2-A, the dash indicating the change from the rigid wheel base to a truck or bogie.

⁽²⁾ See the article by the same author in the August 1931 issue of the *Bulletin*, p. 703.

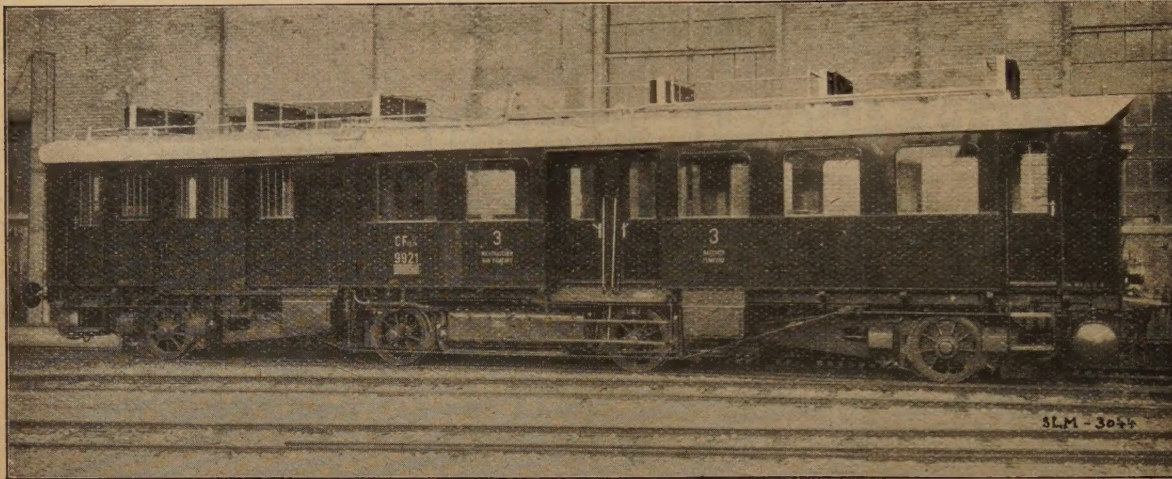


Fig. 1. — 300-H. P. rail motor coach with Diesel motor, type A 2 A, with radial axles, in service in Switzerland.

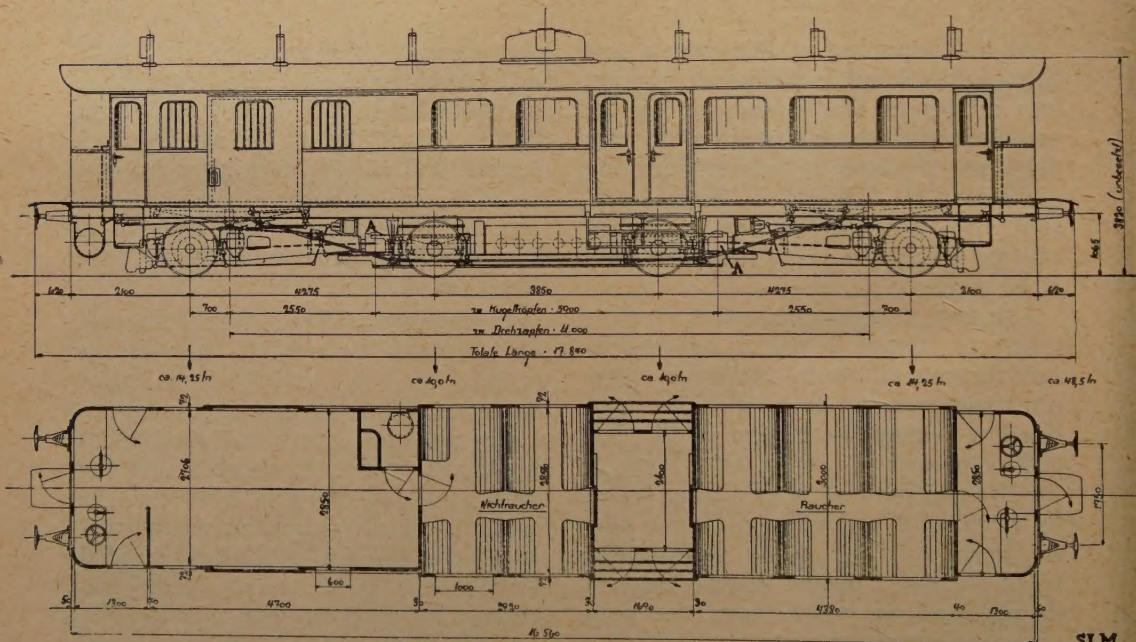


Fig. 2. — The rail motor coach of figure 1, No. 9921, in elevation and plan, showing the wheel arrangement, the spring gear, driving mechanism, and brake gear, as well as the interior arrangement of the body.

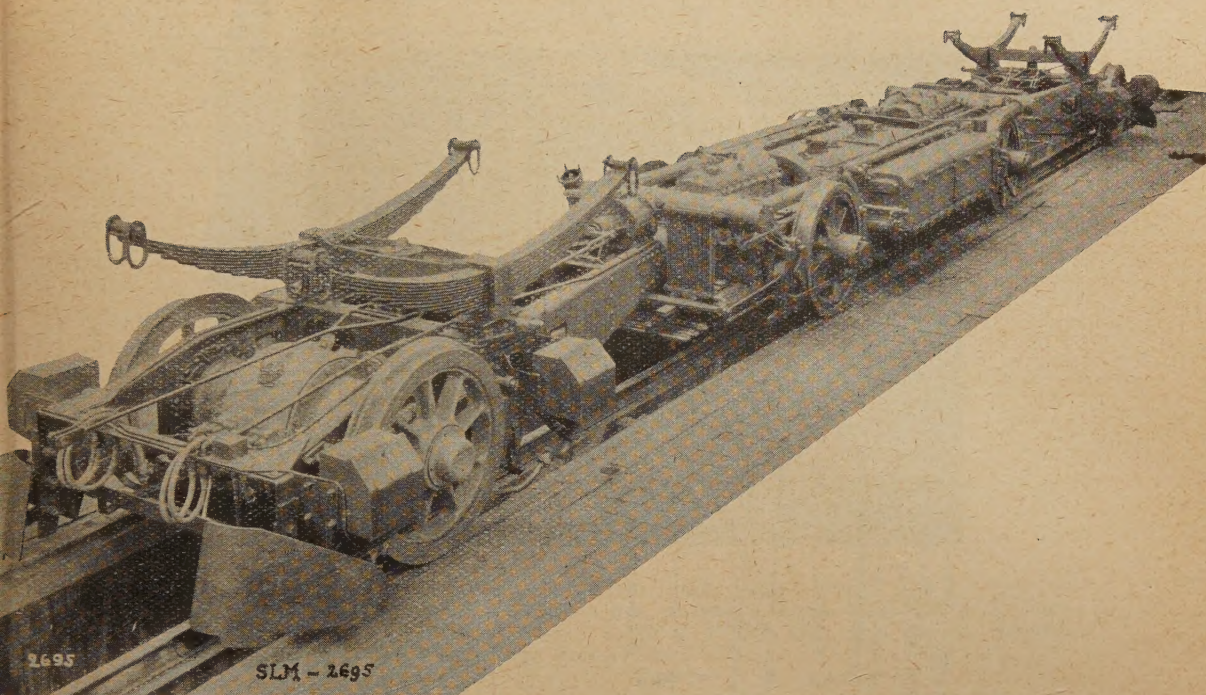


Fig. 3. — View of the wheels with the driving mechanism and spring gear of the rail motor coach shown in figures 1 and 2.

of the rails. The wheel base of the vehicle being large also contributes to give it good riding qualities.

Before further describing the vehicle,

its machinery, and the final test run before it was put into service, we give below the principal dimensions of the Diesel motor and of the carriage :

Motor.

Normal horsepower	300
at a speed in r. p. m.	850
Number of cylinders	12
Diameter	180 mm. (7 5/64 in.)
Stroke of pistons	220 mm. (8 43/64 in.)
Limits between which the speed can be regulated in r. p. m.	350 to 850

Carriage.

Number of speeds : 4, namely	I,	II,	III,	IV
Corresponding in km. (<i>in miles</i>) to approximately .	14 (8.7),	27 (16.8),	45 (28),	72 (44.7)
Maximum speed	75 km. (46.6 miles)			
Gauge	1 435 mm. (4 ft. 8 1/2 in.)			
Rigid wheel base	3 850 mm. (12 ft. 7 3/16 in.)			
Total wheel base on the straight	12 400 mm. (40 ft. 8 in.)			

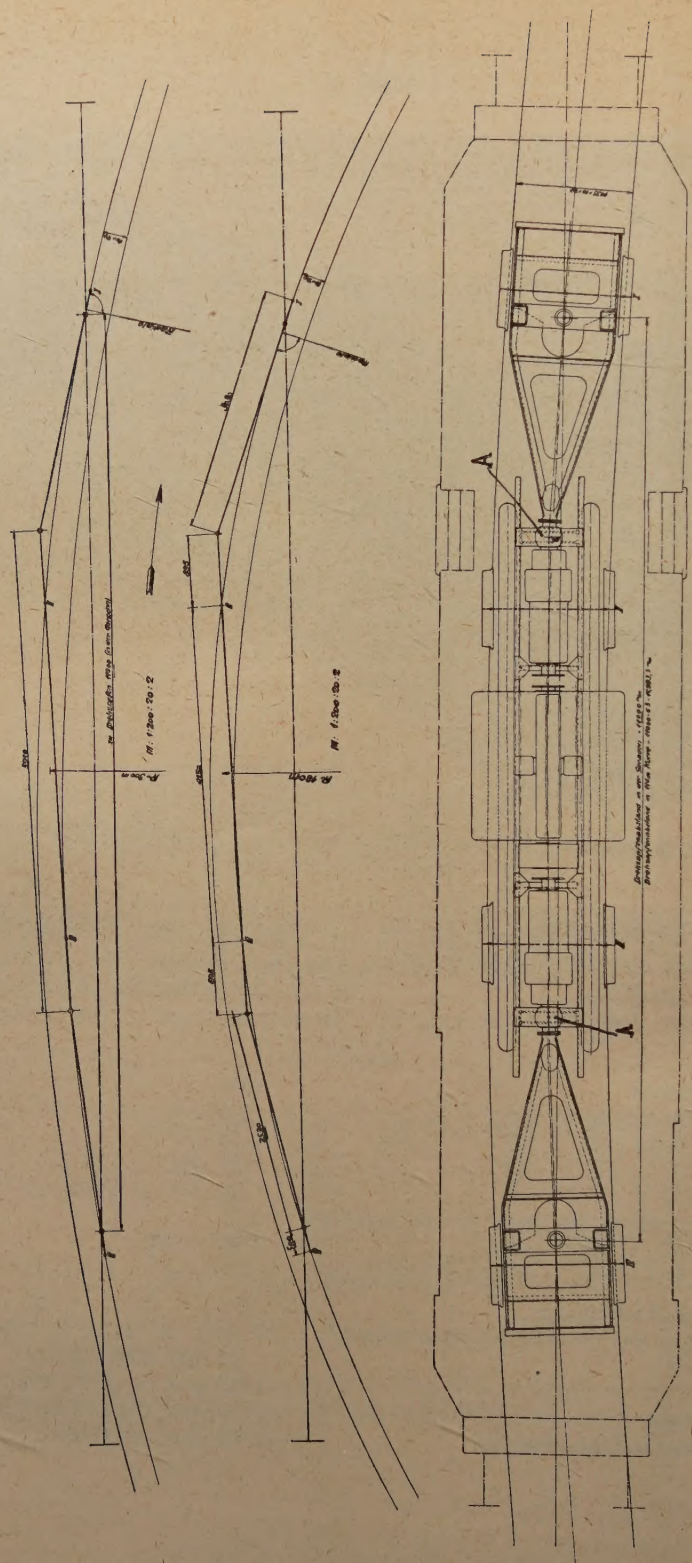


Fig. 4. — Graphical representation of the position on a curve, of the rail motor coach with radial axles, type A 2 A.

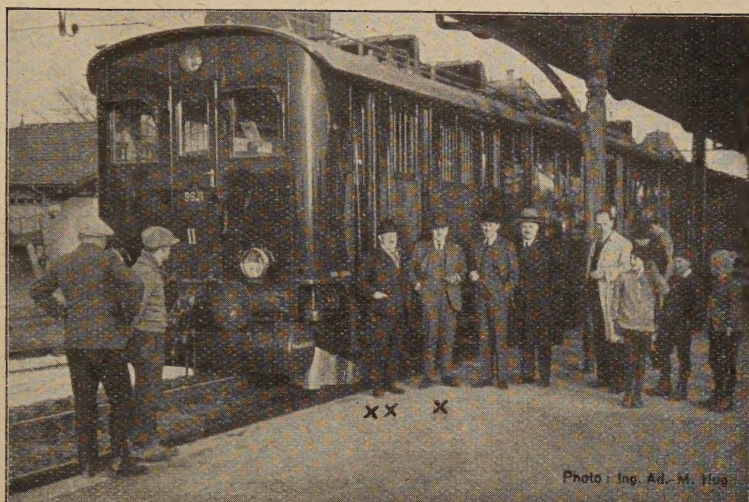


Fig. 5. — Swiss rail motor coach No. 9921 with Diesel motor (service type CF 2/4), on a trial run on the Winterthur-Romanshorn line, on the 1 March 1932. (× R. E. Kimberley, Chief Mechanical Engineer, Buenos Ayres & Pacific Ry; ×× Dr. O. Denzler, General Manager of the Winterthur Locomotive Works.)

Distance between truck pivots	5 900 mm. (19 ft. 4 9/32 in.)
Diameter of wheels	950 mm. (3 ft. 1 3/8 in.)
Length of body frame	16 600 mm. (54 ft. 5 9/16 in.)
Length over buffers	17 840 mm. (58 ft. 6 3/8 in.)
Width of body	3 000 mm. (9 ft. 10 1/8 in.)
Tare, approximately	40.5 tons
Weight in running order, approximately	42.0 tons
Weight loaded, approximately	47.5 tons
Maximum load per axle approximately (driving axles)	13.5 tons
Minimum adhesive weight, approximately	22.5 tons
Maximum adhesive weight, approximately	27.0 tons
Number of seats	49
Available surface for luggage, approximately	12 m ² (129 sq. feet)

The *motor*, the general arrangement of which is seen in figure 3, is a high-speed Diesel, four-stroke with solid injection; the 12 cylinders are arranged in two banks of six with opposed heads. The piston rods drive in pairs (opposite cylinders) on the six cranks of the crank axle carried in seven bearings. The power of 300 H. P. can be increased moment-

arily by 10 to 15 %. The valves and fuel pumps placed on different sides of the heads of the two opposed cylinders are easily got at from the sides of the motor coach, once the aluminium covers have been removed. Everything is arranged in such a way as to make the height of the motor the least possible, and this has made it possible to mount it indepen-

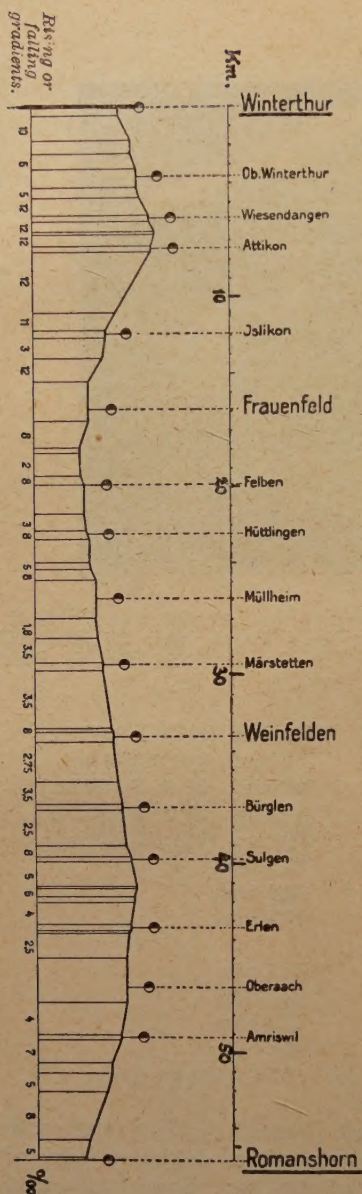


Fig. 6. — Profile of the Winterthur-Romanshorn line (Swiss Federal Railways).

dently of the body and under the latter. The crank shaft can be examined and the pistons removed through an opening

arranged in the floor with moveable panels. The fuel is injected into each cylinder separately and without compressed air by a fuel pump belonging to each cylinder; the quantity of fuel is regulated by means of a hydraulic regulator. This latter is so arranged that the motor gives its normal output at all speeds between 350 and 850 revolutions per minute. The lubrication is automatic, under pressure. The motor is cooled by means of water circulated by means of a centrifugal pump through six radiators placed on the roof, at right angles to the direction of running (figs. 2, 4 and 5). The motor is started by means of compressed air at a pressure of 15 to 28 atm. (213 to 398 lb. per sq. inch).

The *transmission*, taken from both ends of the crank shaft through two gear boxes controlled by oil under pressure, on the « S. L. M.-Winterthur » system, makes it possible to give the vehicle the four working speeds given in the table. The control of these speed gear boxes is by a transmission device controlled from both driving compartments at the ends of the coach. The fourth speed is direct. The toothed wheels are always in mesh and the different speeds are engaged by friction clutches engaged or disengaged by oil under pressure ⁽³⁾. The construction of the pressure oil distribution valve is such that it is impossible to engage more than one speed at a time.

The *driving of the axles*, which are carried on roller bearings, is through two large conical gear wheels placed on

(3) See the book by the late Professor I. FRANCO, formerly chief mechanical engineer of the Netherlands Railways: *Internal Combustion Locomotives and Motor Coaches*, The Hague, 1931, or the French translation of this book.

each of the two driving axles; a conical pinion placed at the end of the cardan shaft (in each case for each driving axle) remains constantly in mesh with these large conical wheels. According as one or other of these wheels is coupled to the axle, which is done by means of a dog clutch, the vehicle runs forward or backward. The frames of the trucks are built up of riveted plates: these trucks, through long plate springs which pivot on their base (spherical pivots), carry the body (see fig. 3).

The operation of the rail motor coach is very simple: a wheel placed on the control stand regulates the speed of the motor, which is identical moreover for each of the four speeds and in both directions of running. When starting the train the driver has only to place the control lever in the position for the 1st speed, the motor running at about 350 revolutions per minute; the vehicle starts away smoothly and the speed of the train increases until that of the motor reaches 850 revolutions per minute. When passing to the second speed, the revolutions of the engine are reduced to about 500, and so on. The reversal of the direction of running is done by means of a lever. The rail motor coach being designed to be driven by one man a « dead-man's handle » arrangement (well known in electric traction) is fitted and this cuts out the motor and applies the brake of the vehicle. The automatic brake is by compressed air on the Westinghouse system. On long down gradients the Diesel motor can also be used for braking.

The driving compartments are also fitted with a tachometer indicating the speed of the motor, a lever for the sanding valves as well as gauges for the compressed air used in starting and the tem-

perature of the water. The speed of the vehicle is indicated by a speed indicator of the « Teloc » type.

This rail motor coach was entirely designed and built by the « Swiss Locomotive and Machine Company » of Winterthur. The author of these lines who had the opportunity of seeing this rail motor coach in different stages of construction was privileged to assist on the 1 March 1932 at a test run of 112 km. (69.5 miles) (Winterthur to Romanshorn and back), during which the speed was maintained almost constantly at 70 km. (43.5 miles) per hour; the rail motor coach hauled a six-wheeled carriage so that the total weight of the train was about 61.5 metric (60.5 English) tons. The total consumption of fuel (heavy oil) was about 64 kgr. (126 lb.), which corresponds to about 9.3 gr. per gross tkm. (8.6 drams per Engl. ton-mile). Figure 5 shows the train during one of the stops at a station on the run; figure 6 shows the gradient section of the line from Winterthur to Romanshorn, on Lake Constance.

During the test run mentioned above the steady running of the motor coach was noticed which, in spite of its small weight (with 42 t. of tare it weighs little more than an ordinary main line bogie carriage), behaved very well both on the straight and on curves at all speeds up to 75 km. (46.6 miles) per hour; in the middle of the coach in particular, the compartments reserved for the passengers, the running was very smooth and the vibrations as well as the noise of the motor hardly noticeable.

Since the beginning of March 1932 the rail motor coach is in regular service on a secondary line of the Swiss Federal Railways.

One-man operation of electric locomotives and motor coaches on the Central European Railways,

by F. STRAUSS, Vienna,

Technical Expert of the International Labour Bureau, for one-man operation of railway trains.

The principal savings derived from electric as compared with steam operation (savings which have to be sufficient to meet the interest on the capital outlay entailed) can be classified under three main heads, namely, labour, power and maintenance. Of these three sources of economy, that due to the saving of labour charges is undoubtedly the most important, and under this heading economy in traffic operation is the main factor. Modern electric rolling stock is so constructed that two skilled attendants (a driver and a trained assistant) are unnecessary, and there is nothing whatever for an assistant to do during the journey. It follows that one man is sufficient for driving such stock.

In speaking of one-man operation of electric trains it is necessary to distinguish between :

One unaccompanied driver (as is the practice in Switzerland), which is literally the manning of motor vehicle by one man only, and

Driving with only one skilled man (as in Germany and Austria), in which case the driving compartment is occupied during running, by the driver and by another employee who takes the place of a skilled assistant. The second employee is usually the guard and it is his duty to operate the brakes; he will be referred to as the driver's assistant.

The German State Railways decided to adopt the system of driving with one

skilled man on account of the requirements of the Railway Control Board. The German Construction and Operation Order prescribes in paragraph 63, subsections 2 and 3 :

Every locomotive when being worked must be manned during the journey, with a driver and a fireman. On locomotives which do not burn fuel the fireman is to be replaced by an assistant. On passenger trains which travel at a speed higher than 75 km. (46.6 miles) per hour, the assistant must be specially trained in his duties. The Control Board may sanction the employment of one man alone for shunting operations of the simplest character, and also for the running of single light locomotives on which no fuel is burnt (§ 54/1).

The driving compartment of a motor coach running in service must as a rule be occupied by a driver and an assistant. The assistant may be dispensed with if arrangements are made which enable one of the train staff to obtain access to the driver's compartment at any time. The Minister of Transport is empowered to sanction other exceptions where the circumstances are of a simple character.

As laid down in § 63 of the Railway Construction and Operation Order, all electrically-driven trains which may run at a maximum speed of 75 km. per hour must have two men in the driving compartment, but trains of this kind are in fact run with one skilled man and an assistant.

The real difference between the one-man operation of the Swiss Federal Railways and the one-skilled-man operation of the German State Railways is that in Switzerland the driver alone is responsible for keeping a look-out for signals when one-man operation of locomotives is in force. The head guard is relieved of this duty and can perform any duties required in his van or be employed for ticket inspection. In Germany, on the other hand, both the driver and the guard are required to keep a look-out for signals in accordance with § 9, subsection 36, of the working instructions. Consequently the guard cannot be used for ticket inspection duties on the train. For this reason the German State Railways decided to station the guard in the driving compartment, since he would in any case have to look-out for the signals, and by changing his position from the guard's van the required two men are present in the cab, although only one is in the skilled category.

The changeover from two-men operation to one-man operation or one-skilled-man operation presents a difficult problem from the point of view of the absorption of labour. Arrangements have to be made well in advance for finding employment for the displaced men, which include, for example, firemen of steam locomotives who are no longer required when electrification is carried out and only one skilled man is required on the electric vehicle, also the skilled assistants from electric vehicles that had previously carried two skilled men in the driving compartment. Early attention to these points is imperative since it contributes largely to the ready acceptance of the drastic changes by the particular class of railwaymen involved.

On the Swiss Federal Railways the electric vehicles were not worked by one-man

when they were first put into service, but carried a driver and a skilled assistant. One-man operation was introduced only after electric working of the main lines had been in operation for several years; it was first employed on motor coaches in 1923, and came into force on electric locomotives as from the 15 May 1927. The change from running electric rolling stock with two men, to operating it with one man could not, of course, be extended to the whole system on the same date. On the contrary the men received an assurance that one-man operation would not be brought into force at a more rapid rate than would correspond to the natural reductions of the pay-roll, and no assistant in a recognised grade, such as that of assistant driver, would be sent back to the workshops.

The German State Railways provide a typical example of the transition from steam working, with locomotives carrying two men, to electric locomotives operated by only one skilled man.

Operation with one skilled man was generally put into force immediately upon the opening of the individual electrified sections, within the limits imposed by the Railway Construction and Operation Order. Several years before the inauguration of the electrified lines preparations were in progress on the various steam lines with a view to the adjustment of the labour conditions to suit operation with one skilled man. The staff depot concerned knew exactly how many firemen would become superfluous when electric working became operative, and made such arrangements as were necessary.

The surplus railwaymen who became available through the electrification of the passenger and freight train services were transferred to lines on which steam locomotives continued to be used. Where they could not be utilised for steam loco-

motive duties, the men were assigned temporarily to trainmen's duties (brakesman). They remained on this class of work until vacancies, through retirements on pension, deaths, etc., for firemen could be offered to them in their particular districts. It should be mentioned that the surplus firemen, as a matter of principle, received the same wages when acting as brakesman, and no variation could be made except in relation to output allowances.

Also in the case of the Augsburg-Stuttgart line which is to be electrified shortly, measures were taken in the direction of economising labour; as early as a year beforehand no new applications were considered, and such vacancies as occurred were not filled; these preliminary steps facilitate and render safer the programme of changing over from running steam locomotives with two skilled men to operating electric rolling stock with only one skilled man.

The Report of the Committee on Main Line Railway Electrification in England (the Weir Report) of 1931, contains a definite expression of opinion on this question. It states that the effect of a comprehensive electrification programme extending over a period of twenty years, on drivers, firemen and cleaners will call for careful examination. The Committee had come to the conclusion that railway electrification would have no serious adverse effects on the men occupying these grades, particularly having regard to the fact that any scheme of electrification will result in a considerable intensification of suburban services, as well as of main line traffic.

Requirements of one-man operation.

A. — Swiss Federal Railways.

All the electric vehicles on the Swiss Federal Railways which are worked on

the one-man system are provided with special safety devices (dead man's handle, etc.). The locomotives used in Switzerland are equipped with the Brown-Boveri (B.B.C.) type; the motor-coaches have the Sécheron design; however on all new stock of this type the B.B.C. equipment will be fitted. The construction and method of operation of these safety devices, which are now fitted to the electric rolling stock of practically every railway, are no doubt familiar to all readers, and it is therefore unnecessary to describe them in detail.

The object of the safety switch is to bring about the opening of the master controller on the hauling vehicle in the event of the driver becoming incapacitated, at the same time operating the automatic air brakes throughout the train, and sounding the whistle so that the train staff will bring the train to a standstill.

The safety switch comes into action :

a) On locomotives, after 100 m. (328 feet) have been traversed subsequent to the release by the driver of a pedal which he has to keep depressed when running, or the release by him of one of the control switches;

b) On motor-coaches, immediately after the release of the master controller handle, or of a pedal, but in either case only when the speed exceeds 20 km (12.4 miles) per hour.

Consequently, on locomotives the safety device gives the driver some freedom to move about even at high speeds, whereas on a motor-coach he cannot leave his post unless the speed is less than about 20 km. (12.4 miles) per hour, as for example, when shunting. On locomotives, moreover, a buzzer is sounded after running about 50 m. (164 feet), so that if the safety device has operated through inadvertence or accident, the driver's attention

is drawn to the necessity of depressing the pedal or one of the control switches.

Each safety device is tested once a day, and this is done from the particular driving compartment used when the vehicle is first taken out of the depot. On the 15th and the last day of the month, the test is made from both driving compartments. The driver enters a record of the tests in a small control book which is kept in the No. 1 driving compartment of the locomotive or motor-coach.

Locomotives fitted with the « dead man's » devices are run with one man on :

a) Ordinary passenger trains irrespective of the load, speed or gradient.

b) Fast trains subject to the following conditions :

1. the length of run does not exceed 40 km. (25 miles); or

2. the train can be considered an ordinary passenger train over the greater part of the line; or

3. the train makes frequent stops throughout the journey, provided always that the locomotive makes the return journey on a train for which a single-man locomotive is permissible; through trains and express trains can only be worked in exceptional cases, and not as a matter of routine.

c) Freight trains and when running light.

On any double headed train, only one man is required on the second engine irrespective of whether it is equipped with the « dead man's » device or not. If a locomotive or other hauling unit with only one man is coupled in front of a locomotive carrying two men, the driver's assistant has to change over on to the leading tractor.

Locomotives assisting at the rear or formed in the train and not connected

to the automatic brakes of the leading locomotive, must carry two men.

If a locomotive carrying only one man is used for hauling a train of a class which may not be worked by one man, an assistant driver must be provided, or if the necessity arises, the driver is to be accompanied by some other man who is familiar with the route.

Locomotives manned by a driver only and equipped with the safety device, and running light, do not carry a second man either when working in large or small stations, or on the road; neither is this necessary when the locomotives have attached to them, in conformity with Article 30, § 7 of the F. D. R. regulation, vehicles on which no men are carried. The driver of the locomotive must always be in the forward driving compartment according to the direction of running, both in stations and out on the road; it follows that when the direction of running is reversed he has to change his position. This requirement as to change of position may only be disregarded in the case of reversing for a short distance and when the driver has a good view of the track.

Locomotives not fitted with safety gear may not be worked with one man either in stations, or on the road. The exceptions to this rule are the second locomotive when double-headed, locomotives working at the rear of, or at an intermediate point in a train fitted with continuous air brake, also one-man locomotives engaged on shunting service in accordance with special instructions.

B. — *Berne-Lötschberg-Simplon Lines.*

One-man operation has also been brought into use to a considerable extent on the electrified sections of the Berne-Lötschberg-Simplon Railways and the

associated lines (Gürbetal and Lake Thun Railway, Berne-Belp-Thun-Spiez-Interlaken, Spiez-Erlenbach-Zweisimmen, Berne-Schwarzenburg, and Berne-Neuenburg), aggregating about 250 km. (155 miles) of line. The lighter locomotives on this line, of the 1-B-B-1 type, weighing about 70 tons were operated by one-man from the beginning, i. e. since 1920 and were accordingly used for training purposes. Originally no safety gear was fitted. When running into large stations such as Berne, Thun, Neuenburg, etc., the guard took his place on the locomotive, and at every signal he had to sound the whistle to confirm that he had observed the signal indication. The locomotives are now fitted with the Brown-Boveri « dead-man's » handle like those on the Swiss Federal Railways; the precautions mentioned above are no longer in force and these locomotives are now operated by one man on all trains. The heavier locomotives of the Lötschberg section itself are operated by two men. The older of these engines (1911 and 1913) are probably unsuitable for one-man operation, and moreover it is necessary to run some locomotives double-manned in order, namely, to provide the necessary opportunities for training the men. The motor coaches on the Berne-Lötschberg-Simplon Railways are operated by one-man without a safety device.

C. — *German State Railways.*

As already described, the introduction of true one-man operation on the German State Railways is restricted within definite limits by the regulations of the Railway Control Board.

Practically every electric vehicle on the German State Railways is fitted with safety gear. The German State Railways chose the B.B.C. design because this had

already been operating satisfactorily for a considerable time in Switzerland.

In the event of any accident or indisposition affecting the driver of the locomotive or motor coach, the power circuit of the vehicle is automatically opened, and the train brakes applied. The actual moment when the safety gear comes into operation is governed entirely by the distance traversed, and this can be set to between 130 to 150 m. (426 to 492 feet) according to the class of vehicle. A considerable reduction in the distance of 150 m. is made in the case of shunting locomotives. The question arises in this connection as to the method of regulating one-man operation on locomotives which run into joint international stations. This matter has already been considered by the Vth Committee of the International Railway Association (Electrotechnical) and they have taken in hand the preparation of regulations for the operation in joint stations of motor vehicles carrying only one man.

The safety switching device has been developed as compared with the practice of the Swiss Federal Railways, mentioned above, in the direction of providing a definite indication in both driving compartments, of any disturbances by means of clearly visible warning discs. Since a locomotive or motor coach is put out of action in the event of any fault in the safety apparatus, the latter can be cut out by setting the handle of a valve at the mark « O Man », and after removing the seals and withdrawing the retaining pin, at the same time exposing the warning disc through the window by turning it through 90°.

The safety switch has to be tested each day, in the same way as in Switzerland, by bringing the locomotive to a stand when it is first taken out. The larger engine depots have so-called test sections

on the out-going tracks, e. g. at Munich a test section is arranged on the out-going track and marked with three signboards as follows :

Sign 1 : Release safety switch.

Sign 2 : Buzzer must sound.

Sign 3 : Safety device must operate.

The date and the result of the test have to be entered in a register and signed by the driver who takes out the engine.

Equipment of electric locomotives and motor coaches for operation by one skilled man.

The position occupied by the assistant driver is fitted with a collapsible table, a sprung seat and a shaded lamp to enable the guard to do any clerical work, even on night journeys.

As the assistant is responsible for bringing the vehicle to rest, precautions are taken to make quite clear to him which handles he has to operate, and what steps have to be taken to stop the train; for this purpose a diagram or illustration depicting the various apparatus used for stopping the traction unit is fixed in full view of the assistant in each driving compartment of the newer locomotives. This diagram enables the assistant to ascertain at once what operations he has to carry out, if he does not know them exactly, and act accordingly.

Training and duties of assistant.

Practically every man engaged on train duties or on shunting is instructed how to bring the electric motor vehicles to rest. Each engine depot is responsible for instructing the men attached to it, and for examining them to ensure that they are actually competent for the work. At regular intervals all unskilled assistants undergo a « refresher » course and are

examined to see if they know how to stop electric vehicles.

As already mentioned, a guard who acts as driver's assistant on the traction unit is responsible for looking out for signals. If the man who acts as assistant belongs to another grade of the train staff conductor or is a shunter, he has to assist the driver in looking out for signals and controlling the train. In such a case the guard who has to remain in his van during the journey is not relieved of his obligations to look out for signals.

The greatest advantage derived from instructing train attendants and shunting grades, as well as guards, in stopping electric vehicles, is that on goods trains, for example, the guard can delegate another attendant to take over his duty in the driving cab so that he can remain in the brake van.

Classes of train operated by one skilled man :

- a) Ordinary (stopping) passenger trains.
- b) Motor coach trains.
- c) Goods trains.
- d) Light locomotives.

Operation by one man only is employed in the following cases :

- e) All electric shunting.
- f) Backing locomotives on to the trains.

Economics of one-man operation (1).

The financial saving obtained by one-man operation of electric motor vehicles is very important, and to a great extent determines whether a particular service can be run at a profit.

As an indication of this, reference may

(1) The figures and information for the various calculations relating to the economies were kindly placed at my disposal by the authorities of the respective railways.

be made to the Report of the Committee on Main Line Electrification in England, that was published in 1931. The following figures are given :

Wages of locomotive staff :

With steam working	£ 20 933 425
With electric working	10 778 712

This shows a saving of £ 10 154 713 or 48 % by operating the services electrically instead of by steam. In arriving at this estimate it was assumed « in view of the experience of existing electrified railways that one man was sufficient for driving multiple-unit trains, goods trains and shunting engines. »

A. — *Swiss Federal Railways.*

Some figures will now be given relative to the work done by the men under the one-man operation system, which will throw light on the economics of the method.

On lines on which steam and electric locomotives are operated with two men, an average of 2 900 km. (1 802 miles) was worked per month; the corresponding figure with one-man operation is 3 100 km. (1 926 miles).

The statement, frequently advanced by the men's representatives, that the work done is affected by one-man operation is untenable for the reason that under this system the work is regulated and carried out under precisely the same rules and instructions as apply to two-men operation.

Figures relating to the economic use of locomotives are as follows :

Average distance per month worked by locomotives :

1913. Steam locomotives . .	3 660 km. (2 274 miles).
1926. Electric locomotives. .	5 640 km. (3 504 miles).
1930. Electric locomotives. .	7 200 km. (4 474 miles).

As one-man operation was put into regular operation as from the 15 May 1927, these figures clearly disprove the statement that the economic utilisation of locomotives has been adversely affected by the one-man system.

The following figures for the average distance worked by the whole of the locomotives show that the increase since 1926 has not been due solely to the extension of the electrified lines, nor has it been obtained at the expense of the mileage worked by steam locomotives :

1926	5 450 km. (3 386 miles).
1930	6 800 km. (4 225 miles).

The following data relating to the economy of one-man operation on the Swiss Federal Railways is derived from the report « The economics of electrical operation on the Swiss Federal Railway as shown by a statistical investigation for 1929 », in which Dr. E. Huber-Stockar gives comparative figures between the costs of one-man and two-men operation :

	Average number of traction units.	Number of men each.	Total men.	At Swiss francs per year.
One man	132	1.65	218	9 640
Two-men	270	3.70	998	7 940
Shunting engines	26	4.05	105	7 940

A driver's wages average 9 640 fr., and that of a set of men consisting of a driver and an assistant $7\,940 \times 2$ francs = 15 880 francs. The average pay of an assistant is, therefore, $15\,880 - 9\,640 = 6\,240$ francs. Now one-man operation leads to a saving not of the assistant's average wages, but in the first instance saves only the engagement of beginners at an average pay of 4 540 francs.

The saving achieved up to the present by one-man operation with 225 electric locomotives fitted with safety switches (no account is taken of motor coach stock with one-man operation) is :

$$\frac{225 \times 3.7}{2} \times 4\,540 = 1\,889\,775 \text{ francs.}$$

The saving will increase still further in subsequent years, not only through the extension of one-man operation contemplated, but also because of the saving of wages' increments in respect of the assistant drivers who will be dispensed with.

B. — *Rhætic Railway (Switzerland).*

This line, with a route length of 277 km. (172 miles) is the largest narrow gauge system in Central Europe, and operates over what is undoubtedly one of the most difficult districts. The whole of the trains including the expresses are driven by one man although it should be mentioned that in consequence of the steep gradients the maximum speed is only 50 km. (31 miles) per hour. The total number of locomotive drivers employed on this line is 69; 58 of these are first class and 11 second class. The net wages bill (including payment in respect of social services) is 10 814 francs a year for a first class driver, and 9 411 fr. for a second class driver. If a hypothetical two-man service for the locomotives is worked out, 68 % more drivers would be necessary and therefore the minimum ad-

ditional cost would be $\frac{69 \times 68}{100} = 47$ assistant drivers at 8 900 fr. = 418 300 fr. It follows that the additional expenditure for double-manning the electric locomotives would be 418 300 fr. or 57 % of the present nett wages bill of 730 732 fr. for the locomotive crews.

C. — *German State Railways.*

The scheme of one skilled-man operation adopted by the German State Railways has also resulted in important economies where it has been substituted for the double manning of electric locomotives. The following interesting particulars of the economies in locomotive wages resulting from the introduction of the system on the electrified sections in Bavaria, based on the 1931-32 winter time table may be given :

With the present time table, which compares very unfavourably with that for the previous year 1929-30 on account of the serious falling off of the traffic, the saving resulting from operating with the one-skilled-man system is 363 locomotive men less 20 who are allocated to replace guards for handling and looking after luggage, parcels, etc., on particular passenger trains. Hence the nett saving is 343 men.

The annual wages for a fireman (married with two children) is approximately 5 500 Rm., including output premium, so that the total saving amounts to $5\,500 \times 343 = 1\,886\,500$ Rm.

D. — *Bavarian Zugspitze Railway (Germany).*

This line which connects the health resort of Garmish-Partenkirchen with the highest peak in Germany, the Zugspitze,

has been operated on the one-man system since it was opened in 1930. Of the total length, 7 1/2 km. (4.7 miles) is constructed for adhesive traction and 11.1 km. (6.9 miles) as a rack railway. The former is operated by four-wheeled adhesive locomotives of 300 H.P. and the mountain section by rack locomotives of 500 H.P. Both types of engine are fitted with the A.E.G. type « dead man's » safety device which has also been used experimentally on the German State Railways.

The following comparison on the economic side between the one-man system and a hypothetical two-men system of working is based on the summer time table of 1931, for the operation of which a total of 8 066 driver-hours were required. If a second man had been necessary on an engine this would have meant 6 936 assistant-hours, and an addition of 50 % has to be made to this theoretical figure as an allowance for preparation for service, reserves, illness and leave. It follows, therefore, that two-man operation of the locomotives in accordance with the summer time table of 1931 would have required an additional expenditure of

20 808 Rm. as wages for the extra 10 404 man-hours.

* * *

It is beyond the scope of this article to include an investigation into the economic results obtained on the numerous narrow-gauge rack railways in Switzerland, which are operated purely on the one-man system, but it may be said that such an investigation would yield interesting results.

Summary.

In conclusion it may be emphasised that the presence of two skilled men is unnecessary on electric traction units. Railway Administrations which have hitherto adhered to two-men operation can introduce the one-skilled-man operation without hesitation.

Reference may also be made to the fact that the Austrian Federal Railways have already decided to depart from the two-men system which they have hitherto employed for their electric locomotives and motor coaches and to introduce at once the one-skilled-man system on their electric locomotives.

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

XIIth SESSION (CAIRO, 1933).

QUESTION VI:

All-metal rolling stock : carriages and wagons. Use of light metals and alloys. Use of autogenous welding.

REPORT No. 2

(All countries except America, Great Britain, Dominions and Colonies, China, Japan, Germany, Bulgaria, Denmark, Finland, Norway, Netherlands and Colonies, Rumania, Sweden, Czechoslovakia, and Turkey),

by R. MARIANI,

Ingénieur, Chef de service au Service du Matériel et de la Traction,
Italian State Railways (Florence).

The report has been drawn up in accordance with a questionnaire prepared in agreement with Messrs. H. N. Gresley, Chief Mechanical Engineer of the London & North Eastern Railway, and E. Dähnck, Reichsbahnoberrat, Deutsche Reichsbahn Gesellschaft (Zentralamt), the reporters on this question, for other countries.

The above mentioned questionnaire was sent to 112 Administrations through the Congress Association.

Of these Administrations, 63 replied to the questionnaire, but only twenty of these supplied information, data, and drawings in any detailed manner, and these we have used as the base on which to build up our investigation.

We would like to express our appreciation to all these Administrations.

* * *

In order to make our investigation clearer, and more simple, we have

thought it advisable to divide it into the following parts :

I. Growth of the stock of all-metal carriages and the adoption of all-metal construction for carriages to be built.

II. Progress of the all-metal construction of passenger carriages from the point of view of the method of construction.

III. Progress in the construction of all-metal passenger carriages from the point of view of the materials and of the manufacturing methods adopted.

IV. Use of light metals and alloys in passenger carriages.

V. Adoption of all-metal construction for goods wagons.

VI. Use of welding in carriages and wagons.

As a resumé of our investigation, we will then give the conclusions we think can be drawn therefrom, within the limits naturally of what concerns the countries taken into consideration.

I. — Growth of the stock of all-metal carriages and the adoption of all-metal construction for carriages to be built.

On all those Administrations who, in 1930, owned metal coaches, the number during the last years has appreciably increased, although the financial difficulties due to the general falling off in traffic have everywhere slowed down the rates of renewal of the rolling stock.

We find, for example, that from 1930 to 1932 (considering as in service during 1932, coaches which at the 1st of January 1932 were under construction or had been ordered) the stock of metal coaches increased by 2 601 units on the main French Railways taken as a whole (910 units on the State Railways; 527 units on the Paris-Lyons-Mediterranean Railway; 465 units on the Nord Railway; 220 units on the Est Railway; 404 units among the Post Office vans, etc...), and 1 604 units on the Italian State Railways, 658 units on the Polish State Railways, and 356 units on the Swiss Federal Railways, etc.

Moreover, several Administrations which, prior to 1930, had no metal coaches in ordinary service, at the present time possess an appreciable number as can be seen by referring to column 10 of the table given in Appendix 1.

The development of the construction of metal coaches on the different Administrations can be shown by the percentages of the total stock of metal vehicles in service in relation to the total stock better than by absolute figures. These percentages are also given in the table of Appendix 1, and relate to carriages in service at the first of January 1932. The following are some of the percentages: 23.7, Italian State Railways; 20.5, Egyptian State Railways; 17, French State Railways; 16.8, Prince Henri Railways; 8 to 11 % in the case of the French Nord, Midi, and Paris-Lyons-Mediterranean Railways.

The whole of these metal vehicles are

used exclusively on the main lines, or on the suburban or the secondary lines.

On the other hand, we have not received particulars of any metal vehicles being used on the metropolitan railways and tramways, although in several of the countries included in the present report, there are important lines of the kind, upon which all-metal vehicles are used.

The whole of the Administrations who now possess metal vehicles, have stated in their replies to our questionnaire, that the all-metal construction of the carriages has been adopted on their railways definitely so that for the future when they have to build new coaches, these will be built exclusively in steel. Some of the railways, however have made the reserve that the above decision has been taken for bogie vehicles alone.

The main reason why metal construction has been adopted for the carriages is, according to all the Administrations, that of the greater safety of metal coaches relatively to coaches the bodies of which are built of wood.

But many other reasons in favour of metal construction have been given by the different Administrations, these being:

- a greater rigidity in the joints: this gives the double advantage of greater comfort, as there are no more annoying creakings, and that of keeping the whole of the outside sheeting and all the details fastened to the body framing much more rigidly secure than in the case of a wood body; the result of this is that repairs are required less frequently and consequently the cost of maintenance is less;

- a longer life with the financial advantage of being able to spread the cost over a larger number of years;

- less risk of fire;

- the elimination of the ever growing difficulties experienced in obtaining supplies of wood of the quality required in

the construction of coach bodies with wood framing.

The following colonial railways: Lower Congo to the Katanga (Belgian Congo) and the Morocco Railways, are the only ones who have stated their preference still to be towards wood construction, because the latter in their opinion is better as regards insulation from heat, as metal in warm and very humid climates corrodes easily and the wood coaches can be repaired more easily on the site.

In our opinion the difficulty of repairing metal vehicles in the case of serious damage is the chief reason which hinders the introduction of the construction of metal coaches on the colonial railways mentioned above; the repair of heavy damage to metal coaches does in fact require considerable machine tool equipment. It cannot be doubted however that even these railways which generally have already adopted metal construction for goods wagons on a large scale, will tend in the future towards this form of construction even for their passenger carriages.

II. — Progress of the all-metal construction of carriages from the point of view of the method of construction.

a) *General.* — We have taken into consideration, as is quite natural, only carriages in service, or under construction, or being designed at the 1st January 1932 by the different railways included in our report, *additional to those which were dealt with at the Madrid Congress.*

We should first of all remark that we have not found in the new carriages, whether as regards the general lay-out of the vehicle or from the point of view of the principle of construction, much difference as regards those dealt with at Madrid. The Administrations which prior to 1930 had already adopted a particular type of vehicle, have in its general lines continued to follow this type

even for new construction; the other Administrations who have taken into service metal coaches during the last years only, have adopted types which substantially do not differ from the types already in use.

In actual fact, it could not be otherwise; in the short period of two years only, no great evolution could be expected in the construction of metal coaches.

b) *Interior lay-out and general dimensions of the vehicles.* — Most of the coaches allocated to main line workings are bogie vehicles with side corridors and a vestibule at each end into which entrance doors open. There are however some bogie carriages — Belgian National Railway carriages, diagram No. 4 of Appendix VI (in which we have grouped the diagrams of some of the carriages we have had to consider), and the rebuilt carriages of the Italian State Railways, diagram No. 23, in which side doors give access to the compartments.

In the case of the suburban lines, the most usually adopted lay-out is that of dividing the coach into a small number of large compartments, into which access is given by cross vestibules located along the vehicle provided with side doors of large dimensions, generally operated automatically.

The general tendency is to make the vehicle longer and to increase the interior dimensions of the compartments so as to give the passengers greater comfort. This has also been helped in some cases by the increase of the universal gauge to 3 150 mm. (10 ft. 5 in.) recently adopted, and it is of course from this increase that the Administrations have endeavoured to make the greatest possible profit.

Thus in the case of the most recent vehicles of the French Est Railway (for example carriage A³ 1²/B⁵ yfi — diagram No. 14), as well as the most recent vehi-

cles designed by the O. C. E. M. ⁽¹⁾ (as for example carriage A³ 1/2 B⁵ y/i — diagram No. 19) and in the carriages of the International Sleeping Car Company, the length over head stocks is 22.200 m. (72 ft. 10 in.), while overall lengths little lower than this have been adopted by other Administrations. In the table that we have reproduced in connection with this point, the dimensions of the longest vehicles reported to us by the different Administrations can be examined.

As regards the dimensions of the compartments, we find very great progress especially in the 3rd class compartments where dimensions of 1.690 × 2.039 m. (5 ft. 6 9/16 in. × 6 ft. 8 9/32 in.) in the vehicles designed by the O.C.E.M. (diagram No. 10), 1.610 × 2.050 m. (5 ft. 3 13/32 in. × 6 ft. 8 23/32 in.) in the case of the carriages of the French Est Railway, 1.540 × 2.080 m. (5 ft. 5/8 in. × 6 ft. 10 in.) for the Italian State Railways (diagram No. 22), and 1.610 × 1.940 m. (5 ft. 3 3/8 in. × 6 ft. 4 3/8 in.) in the case of the carriages of the Polish State Railways (diagram No. 28) have been used. The interior dimensions of the compartments of some of the most recent metal coaches belonging to the Railways taken into consideration, are given in the following table

c) *Form of construction.* — Nearly all the metal carriages which we have had to examine, have the body and the under-frame rigidly connected together so as to form a single unit box girder. The principle of the box girder has not, naturally, been carried out in the same way in all the carriages.

These can nevertheless be included in one or other of the following three types of construction :

— The « tubular » type, which is that

in which the side walls, the floor and the roof form a whole resulting in a sort of tubular girder of which the whole side takes part in resisting the stresses to which the vehicle is subjected; the tubular girder is generally reinforced by cross rings, but it has no body framing properly speaking.

— The type with a « body framing », which is the one in which the loads are mainly supported by certain beams which form a horizontal trellis girder of great strength — the frame of the vehicle — and two vertical trellis girders connected together at the top by the carlines and cross braced by the ends and by the inside cross partitions. In this type of construction, the outside plating of the sides plays the role of making sure that the connections do not get out of shape, and of providing the diagonal rigidity of the sides themselves rather than that of helping to take its share of the vertical loads.

— The type which might be called « mixed », in which there is a framing which has to transmit continuously the loads, but in which the plates used to cover the sides or at least some of them, play a vital stress-resisting part, even in taking the vertical loads.

Amongst the carriages we have had to examine, the following belong to the « tubular » type : main and suburban line vehicles of the French Est Railway (fig. 13), and the suburban line carriages of the French Nord Railway (fig. 16).

On the other hand, the carriages of the Italian State-Railway (fig. 20), and even, from some aspects, the metal carriages of the Paris-Lyons-Mediterranean Railway, resulting from the alterations of some wood carriages (fig. 18), can be considered of the « mixed » type.

Finally, in the type with a body « framing » may be included nearly all the other vehicles having, be it understood, the frame and the body connected one to the other so as to form a single and integral structure, such as the Belgian Na-

(1) Office Central d'Etudes de Matériel de Chemins de fer des Grands Réseaux Français (Central Designs Office for Rolling Stock for the Great French Systems).

OWNING ADMINISTRATION.	Series or kind of carriage.	Services worked on.	Type of carriage.	Length of carriage over headstocks, metres (ft.-in.).	Inside dimensions of compartments.		
					Class.	Lengthwise, metres (ft.-in.).	Crosswise, metres (ft.-in.).
<i>Belgian National Rail- way Co.</i>	1st class — 2nd class. Composite: 1st and 2nd classes. — 3rd class. — Composite: carriage and brake van. AWFHV. CWFHV.	All lines.	...	22.000 (72 ft. 2 in.)	...	...	...
<i>West of Spain</i>		Main lines.	...	19.300 (63 ft. 4 in.)	1st. 3rd.	2.122 (6 ft. 11 9/16 in.) 2.268 (7 ft. 5 1/4 in.) 2.039 (6 ft. 8 9/32 in.) 2.039 (6 ft. 8 9/32 in.) 2.039 (6 ft. 8 9/32 in.) 2.039 (6 ft. 8 9/32 in.)	2.030 (6 ft. 8 in.) 1.488 (4 ft. 9 in.) 2.150 (7 ft. 5/8 in.) 1.900 (6 ft. 2 13/16 in.) 1.690 (5 ft. 6 9/16 in.) ...
<i>French State</i>	A ⁸ yfi and A ⁸ c ³ yfi.	Main lines.	O.C.E.M.	21.937 (72 ft.)	1st.	2.039 (6 ft. 8 9/32 in.)	2.150 (7 ft. 5/8 in.)
<i>Do.</i>	P ⁹ yfi.	Do.	O.C.E.M.	21.834 (71 ft. 7 5/8 in.)	2nd.	2.039 (6 ft. 8 9/32 in.)	1.900 (6 ft. 2 13/16 in.)
<i>Do.</i>	C ¹⁰ yfi and C ⁵ Dyi.	Do.	O.C.E.M.	21.635 (71 ft.)	3rd.	2.039 (6 ft. 8 9/32 in.)	1.690 (5 ft. 6 9/16 in.)
<i>Do.</i>	A ⁴ yfi and A ² yfi.	Do.	O.C.E.M.	21.937 (72 ft.)	...	...	...
<i>Do.</i>	A ² Byfi Cyfi and CEyfi. and State.	Suburban lines.	and State.	21.935 (72 ft.)	...	...	...
<i>French-Est.</i>	A ³ 1/2 B ³ yfi. A ³ B ⁴ E ² yfi-C ⁵ Dyi.	Main lines.	Est.	22.200 (72 ft. 10 in.)	1st. 2nd. 3rd.	2.021 (6 ft. 7 9/16 in.) 2.021 (6 ft. 7 9/16 in.) 2.050 (6 ft. 8 11/16 in.)	2.150 (7 ft. 5/8 in.) 1.910 (6 ft. 3 3/8 in.) 1.610 (5 ft. 3 3/8 in.)
<i>Do.</i>	Ay-By-Cy-CDy.	Suburban lines.	Est.	21.240 (69 ft. 8 1/4 in.)	...	...	...
<i>French-Nord</i>	Ayi-AByi-BDyi. Cyj-CDyi.	Do.	Nord.	20.000 (65 ft. 7 3/8 in.)	...	...	...
<i>Paris - Lyons - Méditerranée.</i>	A ³ c ² L ³ g ³ yfi.	Main lines.	P. L. M.	20.640 (67 ft. 8 5/8 in.)	1st.	2.012 (6 ft. 7 3/16 in.)	2.150 (7 ft. 5/8 in.)
<i>Paris-Orleans.</i>	A ³ 1/2 B ³ yfi.	Do.	O.C.E.M.	22.200 (72 ft. 10 in.)	1st.	2.039 (6 ft. 8 9/32 in.)	2.150 (7 ft. 5/8 in.)
<i>Italian State</i>	Az. Bz. Cz.	Main lines.	...	21.870 (71 ft. 9 in.)	2nd. 1st. 2nd. 3rd.	2.039 (6 ft. 8 9/32 in.) 2.080 (6 ft. 10 in.) 2.080 (6 ft. 10 in.) 2.080 (6 ft. 10 in.)	1.900 (6 ft. 2 3/16 in.) 2.140 (7 ft. 1/4 in.) 1.900 (6 ft. 2 3/16 in.) 1.540 (5 ft. 5/8 in.)
<i>Polish State</i>	Bhuxz-Chrx. Chxz. ABChuxz. BChuxz.	Main lines.	...	20.720 (67 ft. 11 3/4 in.)	1st. 2nd. 3rd.	1.940 (6 ft. 4 3/8 in.) 1.940 (6 ft. 4 3/8 in.) 1.940 (6 ft. 4 3/8 in.)	2.190 (7 ft. 2 1/4 in.) 2.020 (6 ft. 7 15/32 in.) 1.610 (5 ft. 3 3/8 in.)
<i>Swiss Federal.</i>	B ⁴ ü.	Do.	...	19.100 (62 ft. 8 in.)	2nd.	1.915 (6 ft. 3 3/8 in.)	2.050 (6 ft. 8 11/16 in.)
<i>International Sleeping Car Co.</i>	Sleeping cars, restau- rant cars.	Do.	...	22.200 (72 ft. 10 in.)	...	...	...

tional Railway Co's* carriages either with end doors or side doors (fig. 2), the carriages of the West of Spain Railways (fig. 3), the main line and suburban line vehicles designed by the O.C.E.M. (figs. 5 and 8), the main line and suburban line carriages of the French State Railways (fig. 10), the carriages of the Swiss Federal Railways (figs. 28 and 29) the carriages of the Polish State Railways (fig. 27), etc.

In the case of vehicles having a body «framing» used on main line working, the problem of the trellis girder for the side walls has been treated in a slightly different way by the various Administrations; the general rule of vertical pillars has been adopted, these being formed of Z, or L, or U rolled sections, or by bent plates, fastened at the bottom to the frame sole bars, and at the top, to each cantrail, which in its turn is as a rule formed by two superimposed angles.

More so than in the main line vehicles, we find some variety in the carriages for the suburban lines; in these vehicles we have the problem of making large openings in the body sides for the doors and the steps giving access to the car. This problem obviously lends itself to different solutions.

In the suburban line vehicles of the State type, the problem has been solved by building up the frame sole bars of two superimposed U bars placed one behind the other so as to give the necessary difference in level for fitting the steps, and by surrounding the door opening by a strong framing formed of a U section bar (fig. 22).

In the suburban vehicles of the O.C.E.M. type, the frame problem has been solved by setting the sole bars slightly back relatively to the body side and surrounding the door opening with a large rectangular frame built up of L sections and plates (fig. 8).

Finally in the case of the carriages for the Nord-Milano Railway (Italy) which are working in a service which

in some ways resembles a suburban service, the sole bar has been cut away in line with the doors and set back the width of the door opening nearer the centre of the frame.

Here again a strong frame built up of plates and rolled sections is provided round the door opening to complete the connection between the lower and the upper members of the trellis girder (fig. 25).

Included in the metal carriages that we have had to examine, there are also metal coaches in which the frame and the body do not form one unit: such are the six-wheeled coaches of the Prince Henri Railways (diagram No. 27, Appendix VI), and the 3rd class bogie vehicles converted from wood carriages of the Italian State Railways (diagram No. 23).

In the first vehicles we have a light body completely independent of the frame, and having its own framing. This body is carried on the frame members and on brackets attached to the sole bars (fig. 26).

The construction of the 3rd class coaches of the Italian State Railways is rather different and more simple. In this case (fig. 23), we have a series of horizontal cross bearers fastened to the frame upon which are secured, by connections in bent plate, uprights which in turn are connected together at the top by two longitudinal bent plates carrying the roof hoop sticks. The frame is of the usual type.

* * *

Before closing this section we must call attention to the particular arrangements which some Administrations have taken to improve their carriages from the point of view of antitelescoping.

Upon this point real progress has been made during recent years. The O.C.E.M., for example, has with this object considerably modified the arrangements of

Figs. 1 and 2. — Belgian National Railway Company.
22 m. (72 ft. 2 in.) all-metal carriages with end doors only.

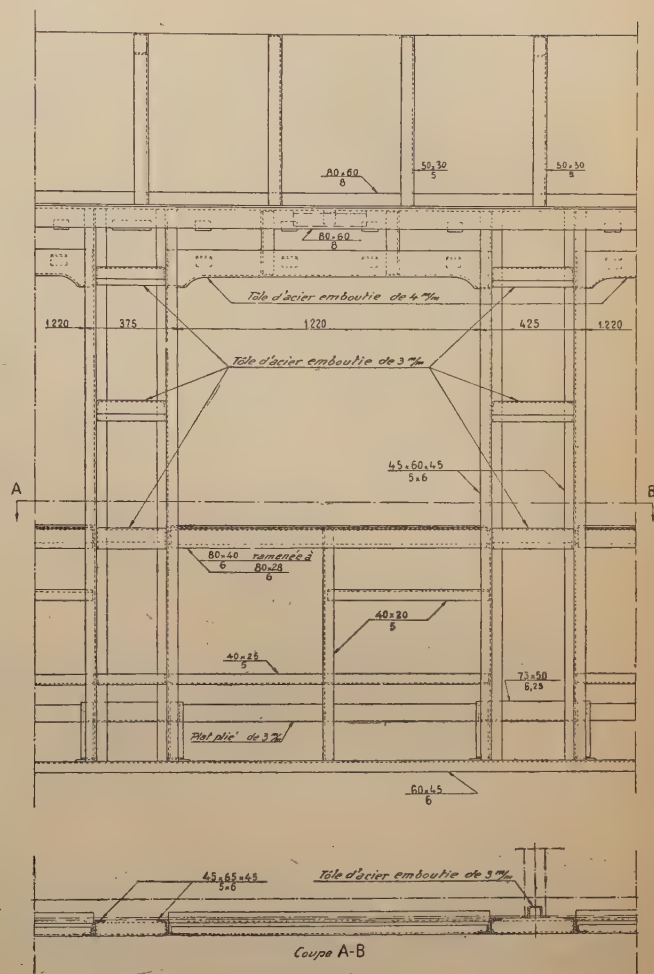
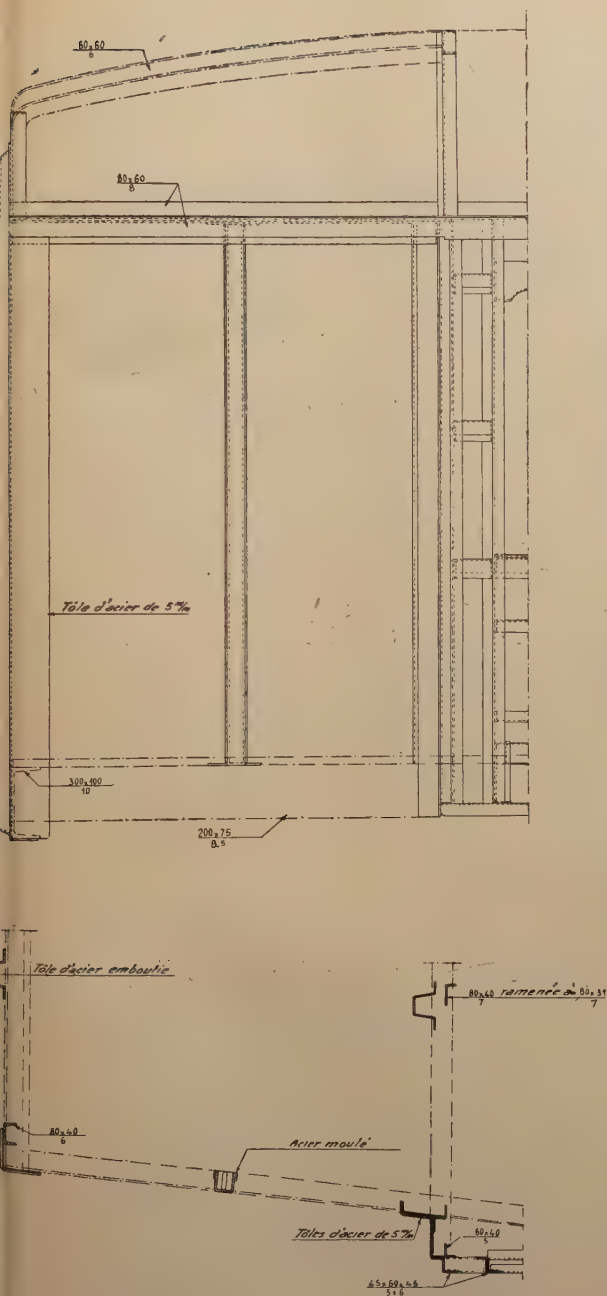


Fig. 2. — Elevation and horizontal section of body sides.

Fig. 1. — Elevation and horizontal section of body ends.

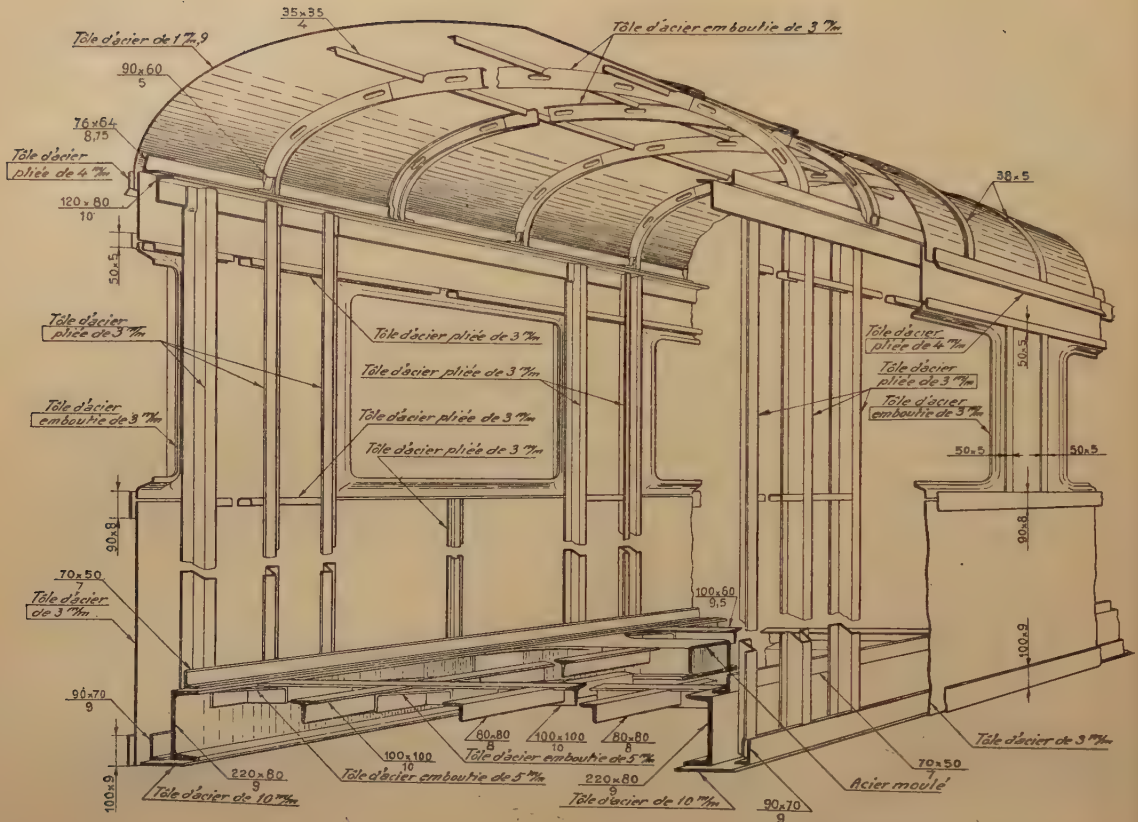


Fig. 3. — West of Spain Railways. — Main line all-metal carriages. — Body-frame.

Explanation of French terms:

Acier moulé = Cast steel. — Tôle d'acier emboutie de ... m/m. = Pressed steel plate ... millimetres thick.

Tôle d'acier pliée... = Bent steel plate...

the ends of the body by adopting in the most recent carriages a large plate 6 mm. (1/4 inch) thick, rivetted along the bottom to the vertical face of the head stock, and bent over at the top on to the ends of the specially reinforced cant rail. The corner pillars themselves of the body which also form the door pillars, have been strengthened by building them up of two 6-mm. (1/4 inch) bent plates rivetted together so as to give a strong tubular section (fig. 5).

In the same way, in the Paris-Lyons-

Mediterranean coaches the end walls are built up of 6 mm. plate (fig. 19) and in the case of the Belgian Railway carriages, strong end pillars pressed out of 8 mm. (5/16 inch) plate are used. Finally in the Italian vehicles, in which anti-telescoping has been looked after with particular care from the introduction of metal construction, because the door pillars, the ends and the curved division of the lavatory form a particularly strong box girder, the anti-telescoping devices have been still further strengthened by

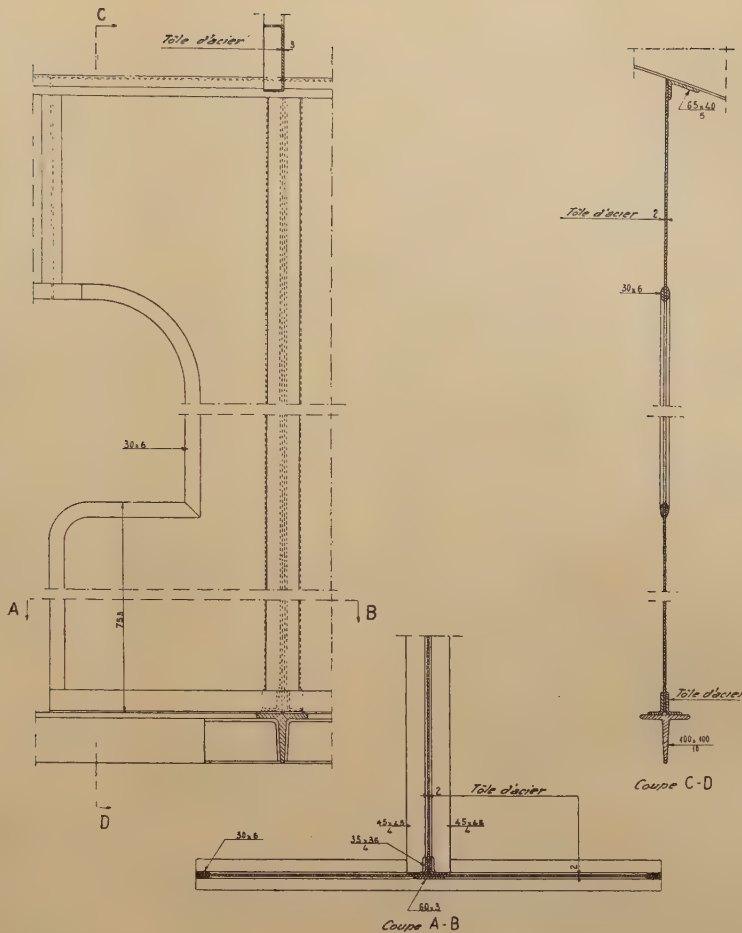


Fig. 4. — West of Spain Railways.

3rd class all-metal carriages. — Elevation and cross sections of the corridor partitions.

introducing at each end of the roof, a 4-mm. (5/32 inch) thick plate (fig. 21).

III. — Progress of the metal construction of passenger vehicles from the point of view of the materials used and the methods of construction.

a) *Principal parts of the frame and body structure.* — As was seen in the carriages built before 1930, we find still

two completely opposed tendencies; one to use to the largest possible extent pressings and bent plates assembled by welding with the object of getting some reduction of tare weight and obtaining outside surfaces as smooth as possible; the other to use chiefly standard rolled sections and plain sheets, so that the construction is easy and can be undertaken by all builders.

The French Est and Nord Railways in particular follow the first tendency.

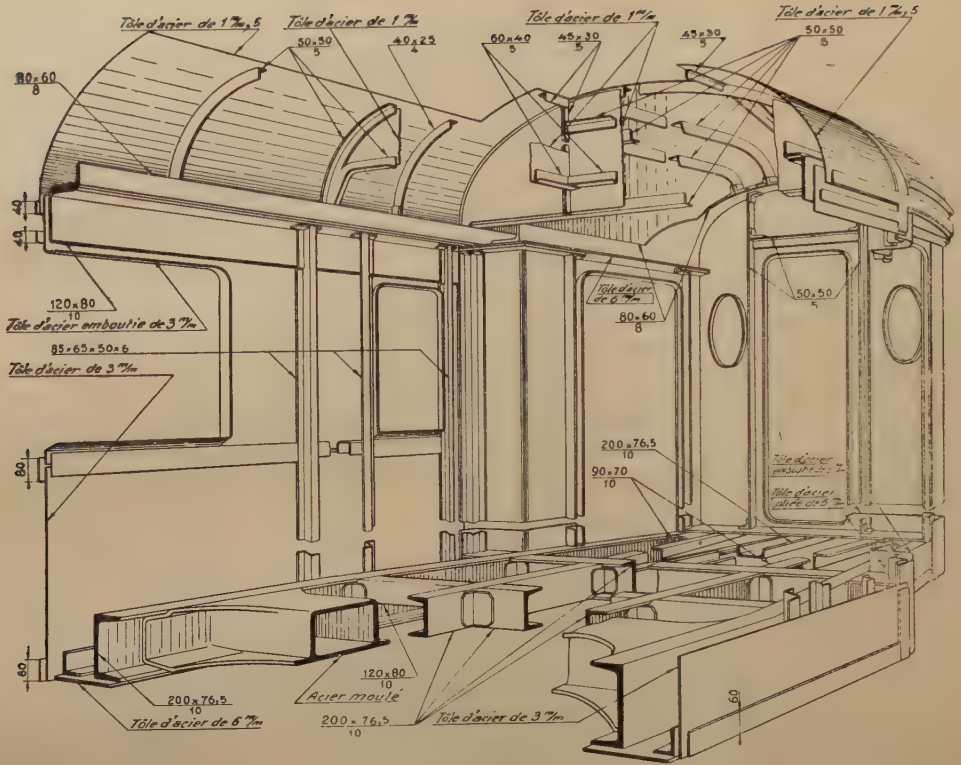


Fig. 5. — French State Railways. — All-metal carriages for main lines, O. C. E. M. type.
Body-frame.

This tendency is even more marked in the most recent vehicles of the Est. The soles and head stocks, as well as the upper longitudinal members forming the cant rails were built up in the first coaches of standard or special rolled sections; at the present time, even these parts are built up of pressings.

The opposite tendency is followed by the Italian, Swiss, Polish and Yugoslav Railways.

Even in the case of the vehicles designed by the O.C.E.M. (fig. 5), and the carriages for the French State (fig. 10) and the Paris - Lyons - Mediterranean (fig. 19) as well as in the case of the Belgian coaches (figs. 1 and 2), and of

the West of Spain (fig. 3), we find a large use is made of pressings.

Certain important parts of the frame and the body are also made of cast steel. The following are some of such parts: bogie bolsters of the Spanish vehicles, and of the main line and suburban line vehicles designed by the O.C.E.M. (figs. 3, 5 and 8); the end castings for the buffer and draw gear of the suburban line vehicles of the French State Railways (fig. 11); the brackets carrying the pillars of the suburban carriages of the French Nord and those designed by the O.C.E.M. (fig. 16); certain parts of the frame, which would be too complicated to make as pressings, of several

carriages and especially of the carriages of the Est and the suburban line carriages of the French State type. In these last vehicles cast steel is used also for

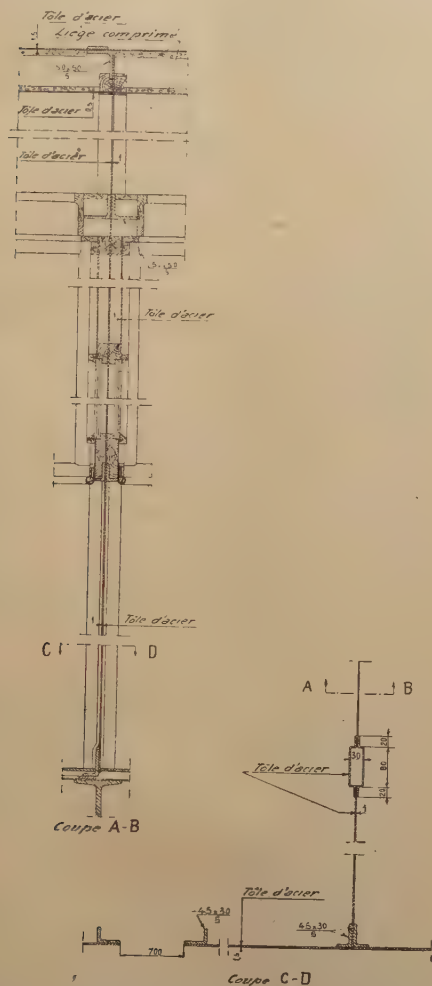


Fig. 6. — French State Railways. — Main line all-metal carriages, O. C. E. M. type. — Vertical and horizontal sections of partitions.

many connections of the members of the body sides (fig. 10).

Finally we find that copper bearing steel has come into wide use, especially for the outside sheeting.

b) *Assembly of the principal parts of the underframe and the body frame.* — Except in the case of carriages for the French Est and Nord Railways, in which even important parts are assembled by welding, in all other vehicles the main members of the structure are assembled by riveting exclusively.

As regards in particular the riveting of the plating forming the outside covering of the body sides, it appears to us that the Administrations are turning in preference towards the methods of fastening by riveting with which it is also possible to obtain smooth faces without the rivet heads being visible, and without outside joint straps, using if need be, special arrangements to get a strong joint, in spite of the thinness of the sheet.

For example, in the latest O. C. E. M. coaches, the rivet heads of the outside sheeting which in the first vehicles had been left with the heads showing, have countersunk heads; and in order to get sufficient thickness of metal in which to drill for the head without using outside cover joints, on the inside face of the plate, flat vertical iron bars 3 mm. (1/8 inch) thick have been spot welded electrically.

In connection with countersunk heads, it may be useful to point out that the Italian State Railways have used them since their first vehicles were put into service, that is to say since 1922, without experiencing the slightest drawbacks from their use.

c) *Bogies.* — As regards the bogies, no improvements worthy of mention have been reported. On the French and Spanish Railways it may be said that the « Pennsylvania » type of bogie in cast steel, frequently in one piece, is used exclusively.

d) *Interior lining of the body sides.* — The interior lining of the body sides of several carriages consists of thin steel sheets and often thin sheets of alumi-

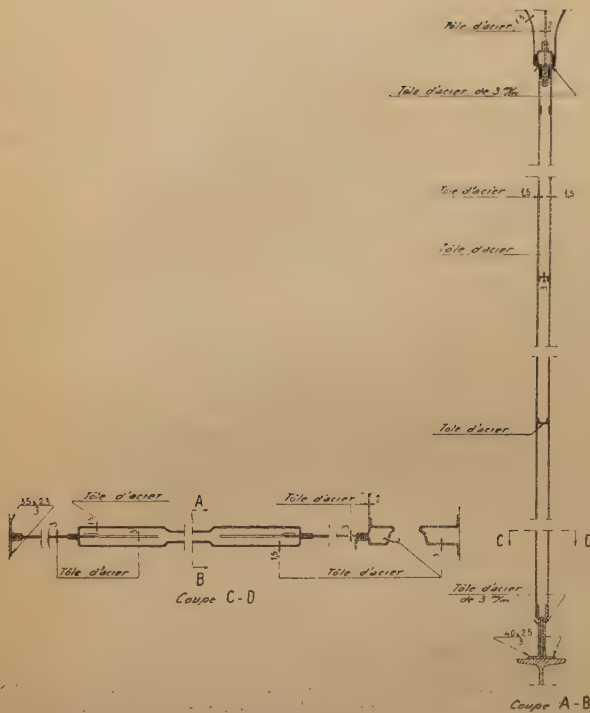


Fig. 7. — French State Railways. — Main line all-metal carriages, O. C. E. M. and State type. — Vertical and horizontal sections of cross partitions.

nium, or aluminium alloys, which in the 3rd class and suburban line carriages are generally painted only, whilst in the 1st and 2nd classes, they are covered with linoleum, imitation leather cloth, or other similar materials. The International Sleeping Car Company uses for the interior linings, the bare steel plate decorated by applying cellulose lacquers thereby also obtaining a satisfactory decorative appearance.

In the majority of cases the plates are screwed on to wood packings bolted to the metal frame work.

There are still a number of vehicles in which the inside of the compartments particularly in the better stock, is lined out with cabinet work, plywood panels

or mouldings, especially the 1st class and 2nd class compartments.

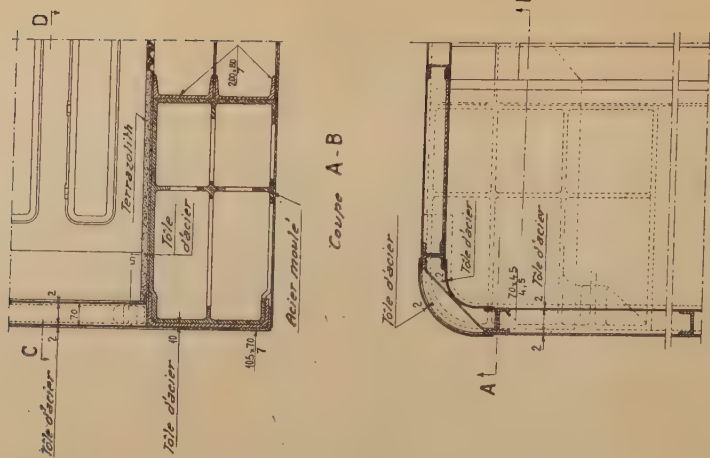
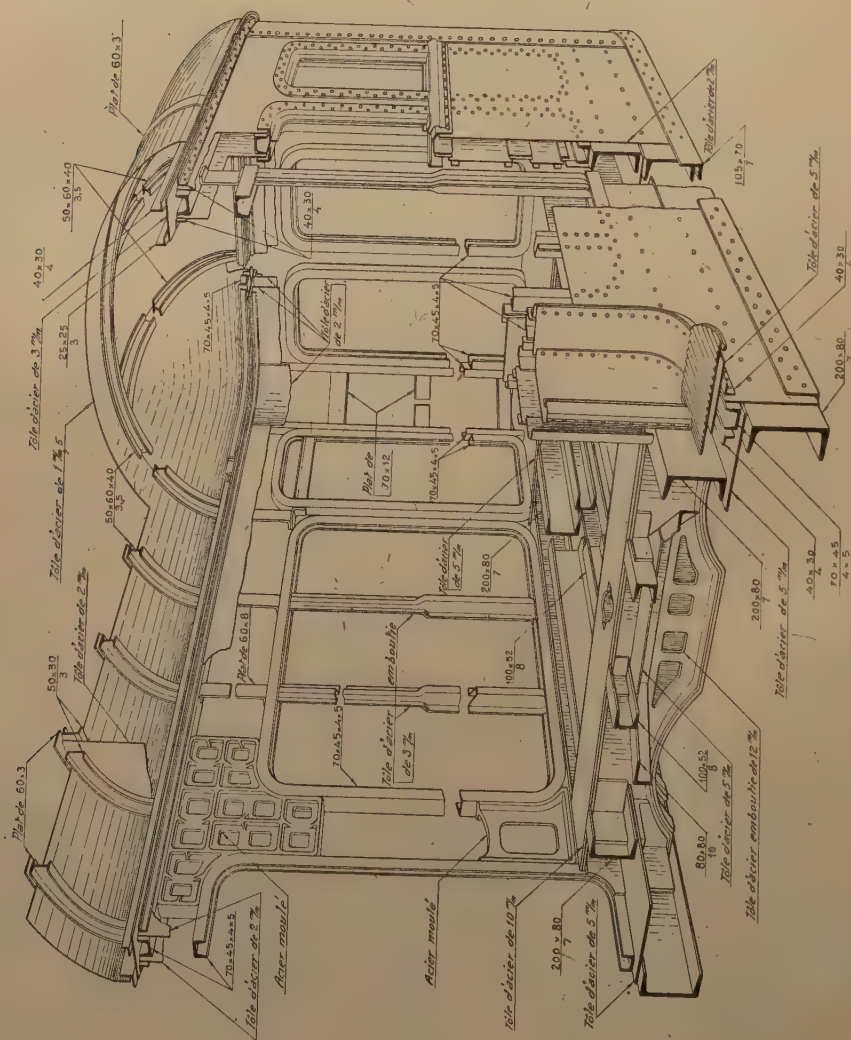
e) *Partitions.* — As regards this a certain amount of progress has been made: all-metal construction has been actually extended to the partitions; in addition, an attempt has been made to simplify the construction and erection, and to improve the connection with the roof framing and the main frame so that the partitions can the better add to the strength of the body by providing an effective method of bracing together the body sides.

Metal partitions built up of steel plates carried on a light framing of small rolled sections or of bent plate, are used in the Belgian coaches, in the West of Spain coaches (fig. 4), in the O.C.E.M. type of main line and suburban line vehicles of the French State, Est and Nord Railways (figs. 6 and 9), in the main line and suburban line coaches of the French State, Est and Nord Railways (figs. 7, 14, 15 and 17), in the rebuilt Italian vehicles (fig. 24), in the coaches belonging to the Sleeping Car Company (figs. 30 and 31), etc.

The plates in the 3rd class are frequently simply painted over; in the other classes they are lined out in wood mouldings to cover the body framing, and these in turn are covered with different decorative materials or hidden by cabinet work.

In the Italian main line vehicles, the longitudinal partition has been built up of a wooden framework, with aluminium panels covered in linoleum or upholstered pegamoid; the cross partitions are in aluminium sheeting fixed on a metal framing to the top of the backs of the seats, and above that in wood connected to the body sides and the roof by metal fastenings (fig. 20).

f) *Floor.* — The floor is built up with galvanised sheet steel or aluminium plate corrugated or channelled, covered with cork or magnesia cement (terrazolith),



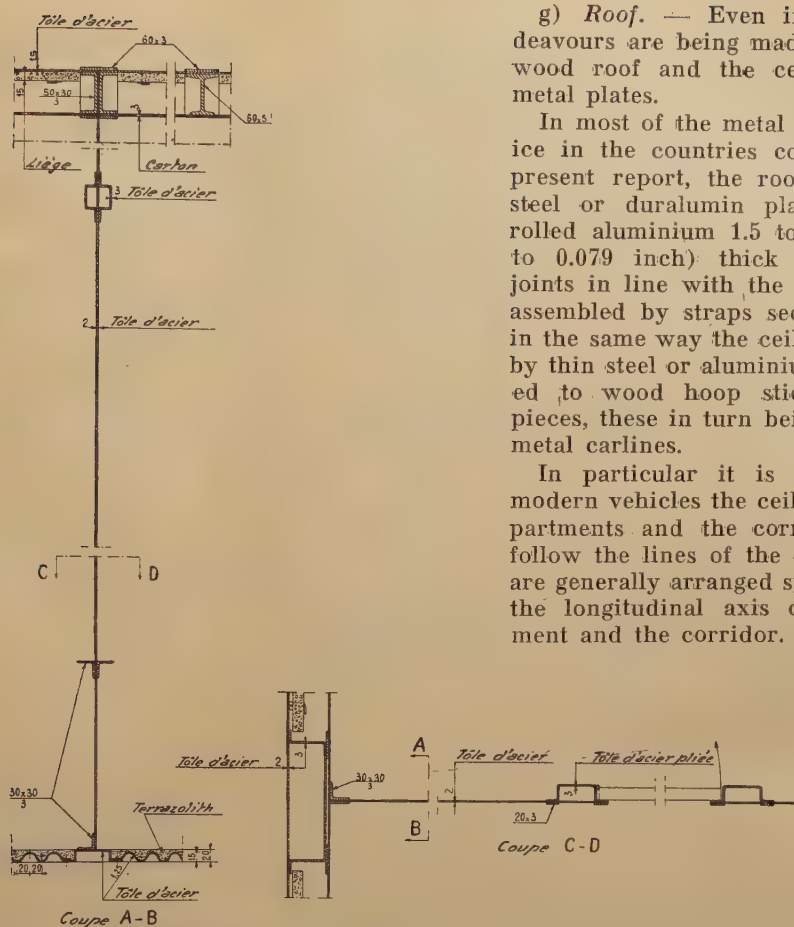


Fig. 12. — French State Railways. — Suburban all-metal carriages, State type.
Vertical and horizontal sections of cross partitions and sections of roof and floor.

and this arrangement is the one preferred by most of the Administrations.

The Polish Railways, the Swiss Railways and the Prince Henri Railways have however remained faithful to the old system of floor built up by top and bottom boards, the space between being fitted with a layer of cork, asbestos, etc.

The French Est, and Italian State Railways use in their coaches a floor built up of wood boards on the inside with a metal plate on the outside.

g) *Roof*. — Even in this part endeavours are being made to replace the wood roof and the ceiling panels by metal plates.

In most of the metal vehicles in service in the countries considered in the present report, the roof is formed by steel or duralumin plate, or by cold rolled aluminium 1.5 to 2 mm. (0.0585 to 0.079 inch) thick butt or lapped joints in line with the hoop sticks and assembled by straps secured by rivets; in the same way the ceilings are formed by thin steel or aluminium plates screwed to wood hoop sticks or packing pieces, these in turn being bolted to the metal carlines.

In particular it is noticed that in modern vehicles the ceilings of the compartments and the corridor no longer follow the lines of the outside roof but are generally arranged symmetrically with the longitudinal axis of the compartment and the corridor.

Undoubtedly the interior appearance of the vehicles is improved very appreciably in this way.

h) *Heat insulation*. — We have not heard of any new arrangement: the insulation is still mainly obtained by means of the layer of air between the inside and outside panelling and by small felt or asbestos mattresses or similar products, such as «Feutrisol» and «Salamander», applied to the inside

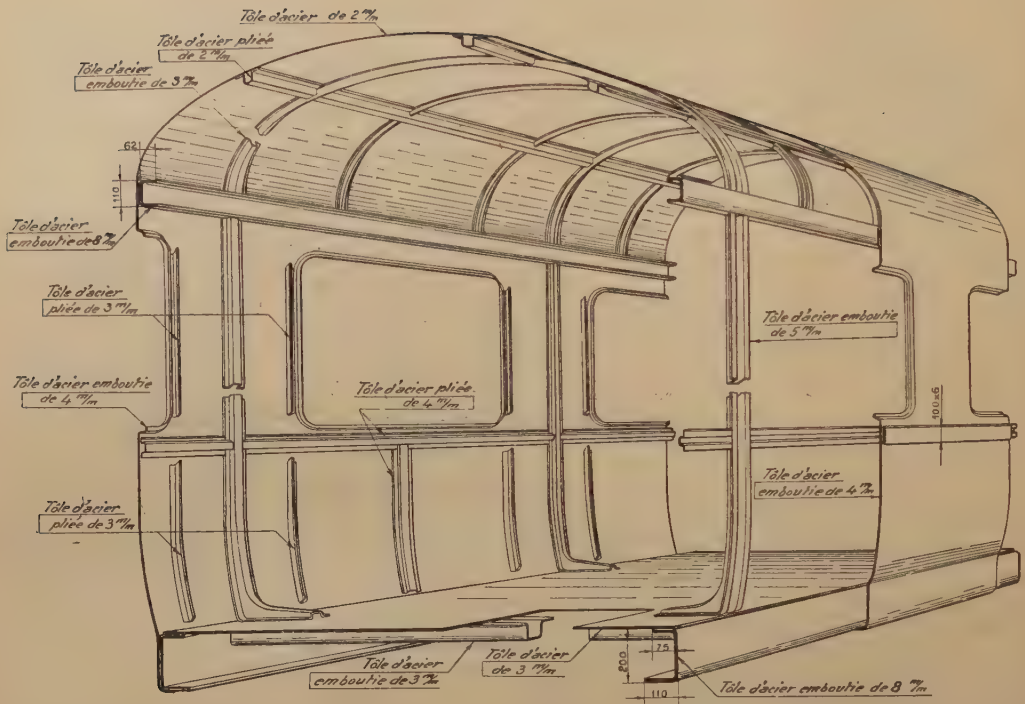


Fig. 13. — French Est Railway. — Main line all-metal carriages. — Body-frame.

or outside panelling and sometimes to both.

In Appendix II we have summarised the principal characteristics of the metal vehicles dealt with in the present report, collected from the drawings received from the different Administrations and from the information they have themselves supplied.

IV. — Use of light metals and alloys in passenger coaches.

When dealing with the interior panelling of the body sides of passenger vehicles, the interior partitions, the roof and ceiling, we have seen that they were often built up of plates of light metal, such as aluminium, duralumin and « alferium ». The use of these metals for the

above mentioned parts is in fact becoming more and more general, so that it may almost be said that all the most recent coaches include parts made of them.

A certain increase in the use of these light metals is to be noticed in the case of fittings (such as seat frames, back frames, window framing, the framework of the seats in suburban stock, certain parts used in connection with the electric wiring or the steam heating) for small interior parts (luggage net rack brackets, light fittings, lavatory fittings, decorative details, etc.) and also for the doors. The French State, Nord and Paris-Orleans Railways, the Belgian Railways and the Italian State Railways are the ones which make most use of these materials.

Figs. 14 and 15.
French Est Railway.
All-metal carriages,

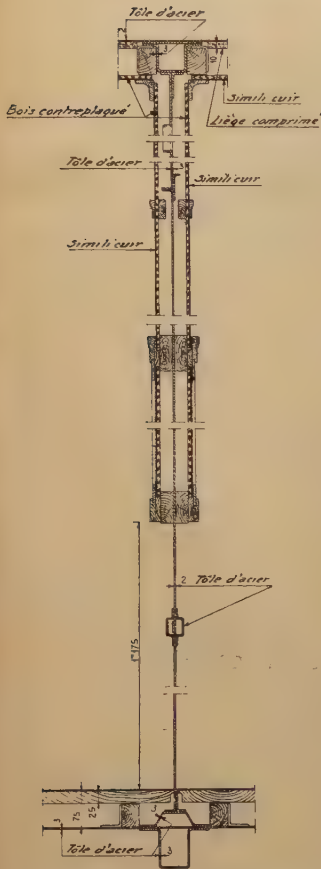


Fig. 14. — Vertical section of cross partitions and floor.

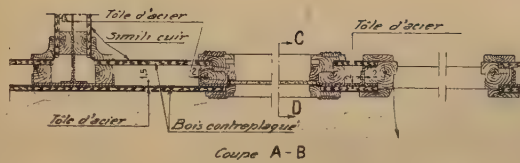
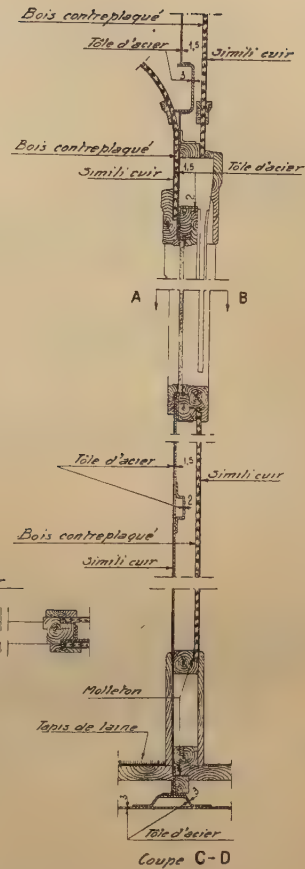


Fig. 15. — Vertical and horizontal sections of corridor partitions.



Up to the present however all these Administrations have stopped at this point. We have not received any report on any coach employed in ordinary working in which light metals have been used for any important part of the body framing or of the underframe.

We consider that the reason why light metals are not used in this latter form is especially one of cost; in order to be able to replace steel in the framing of the coach it is necessary to use alloys having a high unit tensile strength; these

are still too expensive, so that it is not possible to obtain sufficient compensation from the benefits due to the reduction of the tare weight of the coach.

The reduction of the tare weight that can be got by using light metals even when kept within the present limits, is not to be ignored. We have received much interesting information on this matter, some of which may be quoted: in the Paris-Orleans suburban coaches, a reduction of weight of more than one ton has been obtained simply by build-

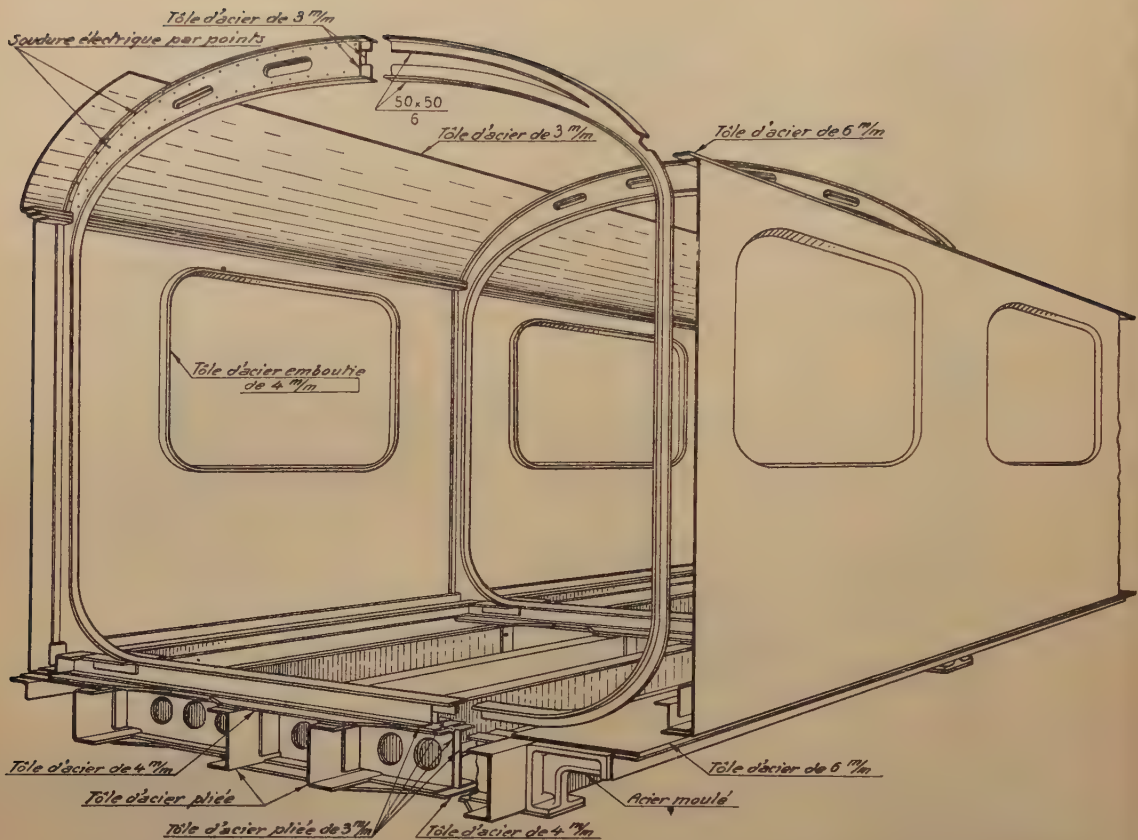


Fig. 16. — French Nord Railway. — Suburban all-metal carriages. — Body frame.

Explanation of French terms : Soudure électrique par points = Spot welded.

ing the outside roof in sheet aluminium 2 mm. (0.079 inch) thick, instead of steel plate of the same thickness, and applying at the same time an interior lining in « alferium » sheet 1.5 mm. (0.0585 inch) in place of 1 mm. (0.0395 inch) thick steel plate.

In the suburban trailer vehicles of the French State Railways which, when no light metals are used, weigh 40 370 kgr. (89 000 lb) the lightening obtained by the use of 1 500 kgr. (3 300 lb.) of light metal in the place of 3 700 kgr. (8 160 lb.)

of steel or iron used in the outside and inside panelling of the bodies, as well as the roof panelling, was 2 200 kgr. (4 860 lb). The Italian State Railways, which have endeavoured to make a maximum use of light metals as can be seen in Appendix III, have been able to reduce the tare weight by nearly 4 000 kgr. (8 800 lb.) in some vehicles, the weight of which would have been 46 000 kgr. (101 000 lb.) had they been built without light metals.

The plates and details in light metals

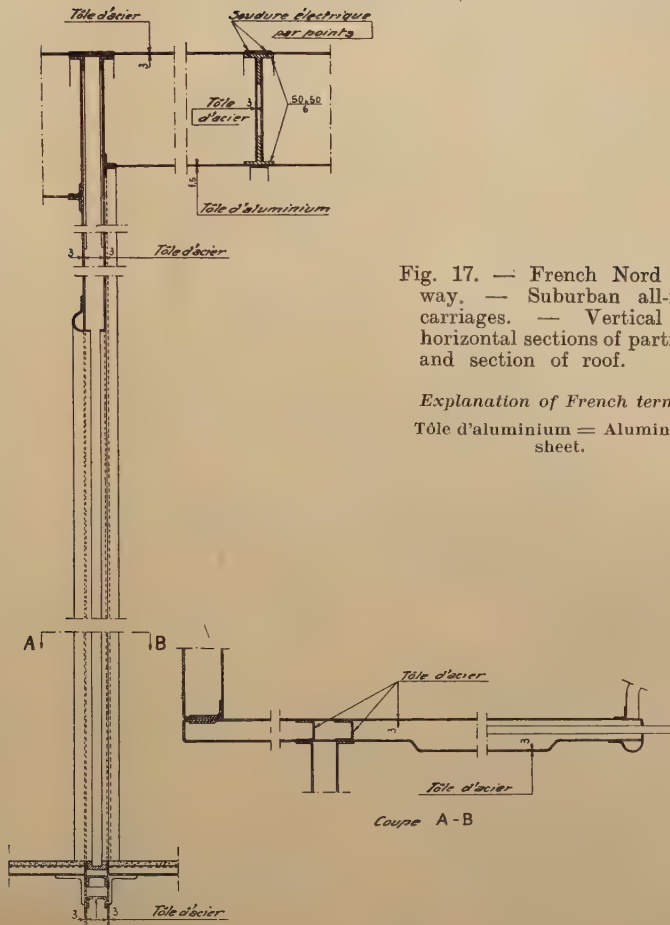


Fig. 17. — French Nord Railway. — Suburban all-metal carriages. — Vertical and horizontal sections of partitions and section of roof.

Explanation of French terms :

Tôle d'aluminium = Aluminium sheet.

are generally assembled by rivets and, in some particular cases, by screws. The rivets are generally ordinary steel or copper bearing steel; the Paris-Orleans Railway however uses screws and rivets of the same metal as the details to be fastened, and the French Nord Railway uses rivets and screws in « Zincual » alloy (alloy of zinc, copper and aluminium).

In order to prevent the surfaces in contact of the light metals and alloys with other metals from corroding —

corrosions that some Administrations have noticed in the first vehicles constructed when no special precaution was taken — it has been found to be sufficient to paint the surfaces with a coat of red lead, or to insert between them calico soaked in red lead paint. Some railways have however also used special varnishes and paints.

As regards the question of price, the general opinion is that the use of light metals does not lead to any increase in cost, if they are used in place of bronze,

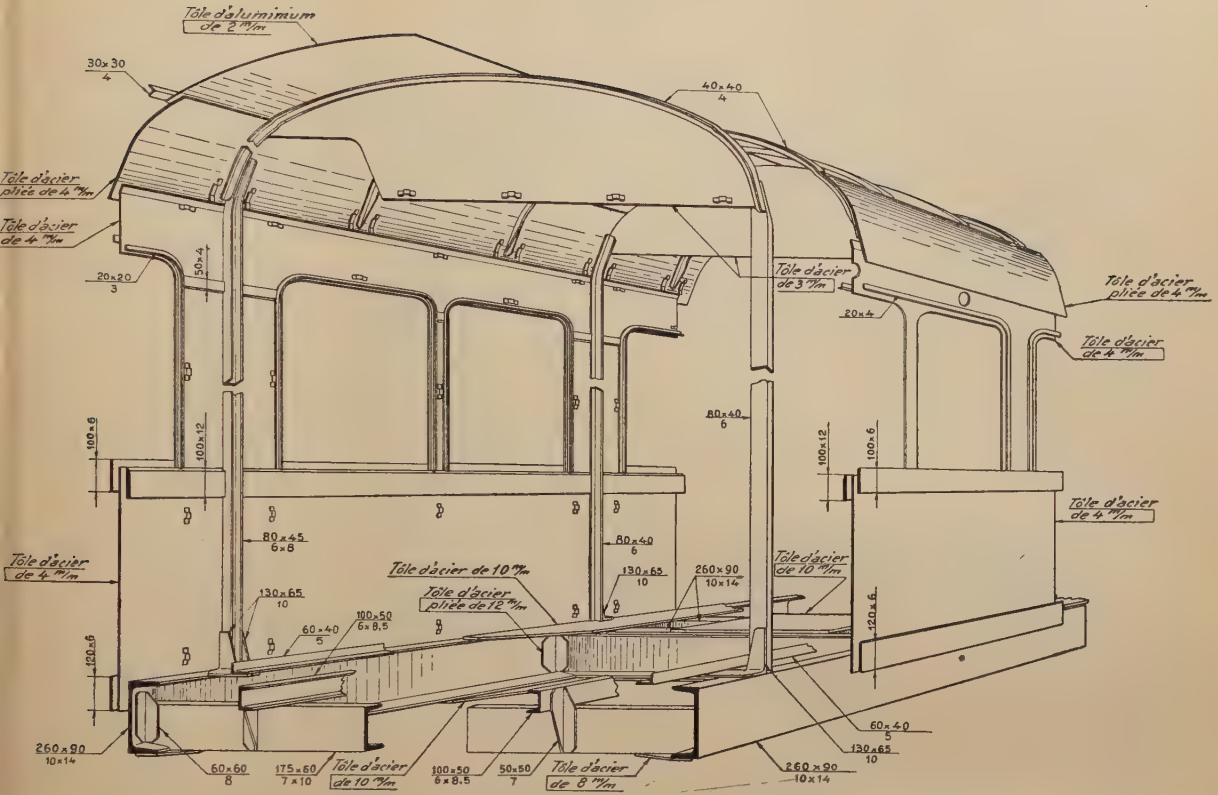


Fig. 20. — Italian State Railways. — Main line metal carriages. — Body frame.

or parts made of steel which are difficult to make, such as doors, but that they involve a certain increase in the cost price if the light metals are used with the object of obtaining a lightening of the weight of the vehicles. This increase in price was for example 3.5 % on the above mentioned vehicles of the Paris-Orleans Railway, and is 18 000 francs for the suburban vehicles of the French State Railways and 7 to 11 % according to the type of vehicle for the Italian State Railway vehicles.

V. — Use of all-metal construction for goods wagons.

The information which follows, relates to covered and open goods wagons used for conveying general goods as well as

coal, coke and minerals. Consequently special wagons such as tank wagons, have not been taken into consideration.

a) *Development of the use of all-metal construction for wagons.* — From the enquiries that we made of the different Administrations as regards the adoption of metal construction in goods wagons, we find, as regards the growth of this form of construction, a remarkable difference between the European Railways, and those of the Colonies and of Egypt.

The European Railways have adopted the all-metal construction (we consider the construction as all-metal, even if the floor is in wood) almost exclusively for open wagons (flats and high sided) and have been so satisfied therewith that

The drawing illustrates the hull structure of a ship, showing various cross-sections and longitudinal sections. The main structure is composed of aluminum sheet metal (Toile d'aluminium étiré) and steel (Toile d'acier). The hull is reinforced with Pégamoid (Pégamoid rembourré) and compressed cork (Gonglonnet de liège comprimé). The drawing includes dimensions and labels for various components, such as the hull plating (Toile d'aluminium étiré), the steel plating (Toile d'acier), the Pégamoid reinforcement (Pégamoid rembourré), the compressed cork (Gonglonnet de liège comprimé), and the hull structure (Toile d'aluminium étiré). The drawing also shows the hull structure (Toile d'aluminium étiré) and the hull structure (Toile d'aluminium étiré). The drawing includes dimensions and labels for various components, such as the hull plating (Toile d'aluminium étiré), the steel plating (Toile d'acier), the Pégamoid reinforcement (Pégamoid rembourré), the compressed cork (Gonglonnet de liège comprimé), and the hull structure (Toile d'aluminium étiré). The drawing also shows the hull structure (Toile d'aluminium étiré) and the hull structure (Toile d'aluminium étiré).

Fig. 21. — Vertical section of body end.
Vertical section of floor and roof.

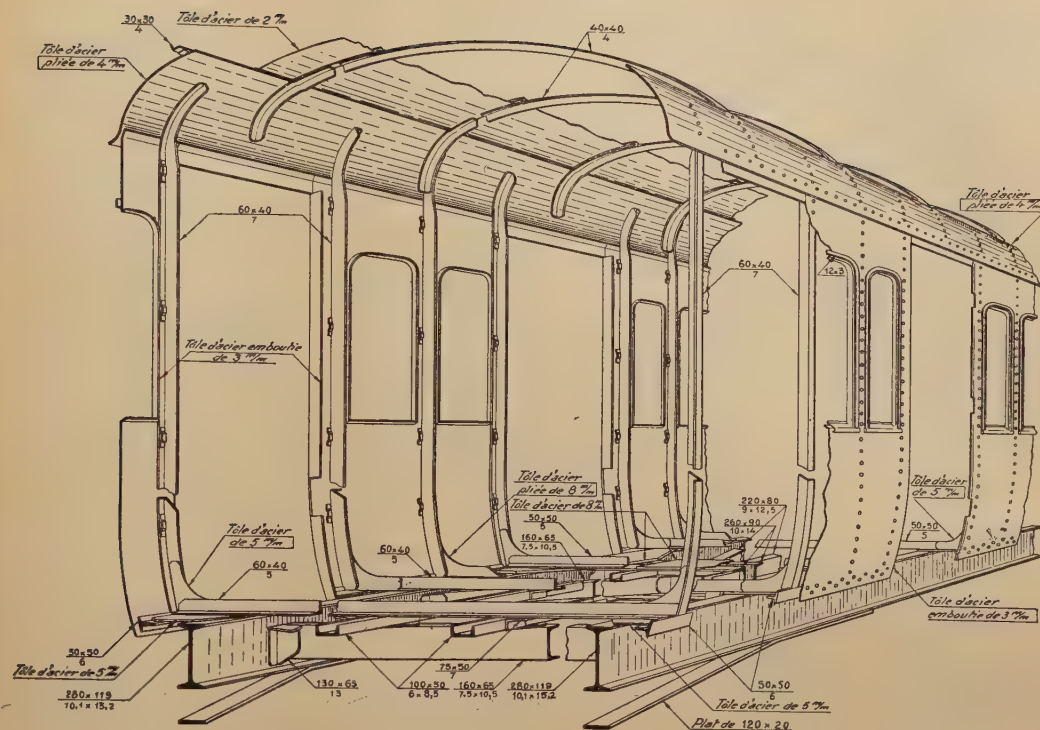


Fig. 23. — Italian State Railways. — Body frame of metal carriages (rebuilt wood-bodied carriages).

they will adopt it generally for all future wagons of the same kind, as they have recognised its superiority relatively to the wood or mixed forms of construction.

This superiority is above all due to the facts that metal carriages are much stronger, that they show a great saving in maintenance, and that there is a better ratio between the useful load and the tare weight.

In these wagons also, the floor is usually in wood because, if made of metal sheet, it would rust quickly under the action of certain materials and through water lodging in the hollows due to the plates themselves being deformed, while it does not lend itself so

well as a wooden floor when securing the wedges normally used for blocking heavy and bulky goods.

In the case of covered wagons, metal construction has been up to the present used by the European Railways in certain exceptional cases only, and even at the present time the general tendency is to prefer to the metal construction, the mixed construction (frame and body framing in steel, body panelling in wood) because it has been considered the most suitable from the point of view of heat insulation and because if the walls were in steel they would be subjected through defective ventilation to rapid corrosion, especially if the wagon is used in the carriage of certain food-

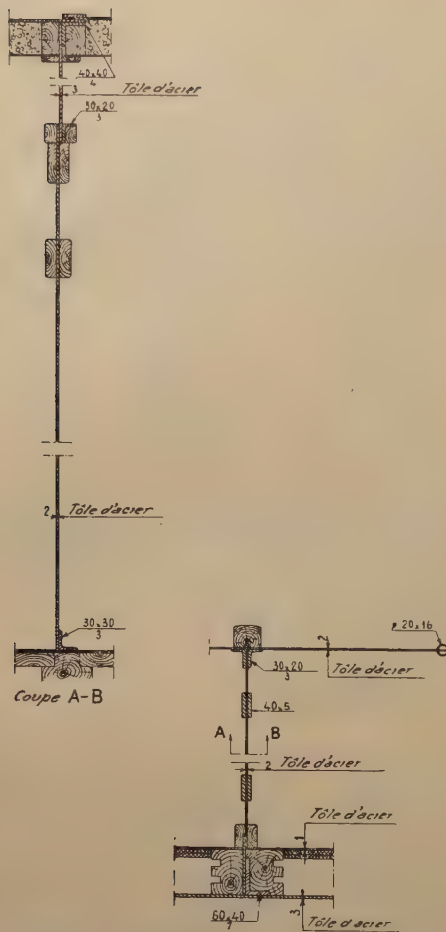


Fig. 24. — Italian State Railways. — 3rd class metal carriages rebuilt on the underframe of wood-bodied carriages. Horizontal and vertical sections of cross partitions.

stuffs (fish, vegetables, fresh meat) or cattle.

On the other hand, according to the Colonial and Egyptian Railways, the all-metal construction is largely used even for covered wagons. The principal reason given, is that the maintenance is less costly, apart of course from the greater strength.

The fact that generally speaking the vehicles in question are of recent build and have had to be imported from Europe may perhaps have had some influence on this situation arising; the metal stock when of equal capacity, is lighter than the wood or mixed construction, and lends itself better to taking down as required when sending them from the Continent to the Colonies.

In Appendix IV we have shown for each Administration who possesses metal wagons and who has supplied information with regard to their upkeep, the percentages of all-metal wagons and of mixed-construction wagons relatively to the total stock and the percentages of the same wagons, divided up according to their type (covered, flat, high-sided) relatively to the total quantities of wagons of the same type possessed by the Administrations considered.

We see that if we except the Prince Henri Railways who report that they have all metal wagons which number more than half of their stock, on all the other European Administrations, the total quantity of metal wagons remains generally below a quarter of the total stock, the highest percentages being 22.9 % (Paris-Lyons-Mediterranean Railway), 22.7 % (Alsace Lorraine Railways), 21.9 % (Belgian Railways), and 21.5 % (French Nord Railway).

If we then analyse these percentages, from the point of view of the type of vehicles, we find it is almost solely due to the open wagons included in it as the numbers of metal covered wagons are almost insignificant. On the contrary the percentages of covered wagons of mixed construction are very high; for example, 80 % on the French State Railways, 77.3 % on the Alsace-Lorraine Railways, 77.1 % on the Paris-Lyons-Mediterranean Railway, and so on, which proves that in spite of the relatively restricted use of all-metal construction, the construction of the framing of the body in wood will completely

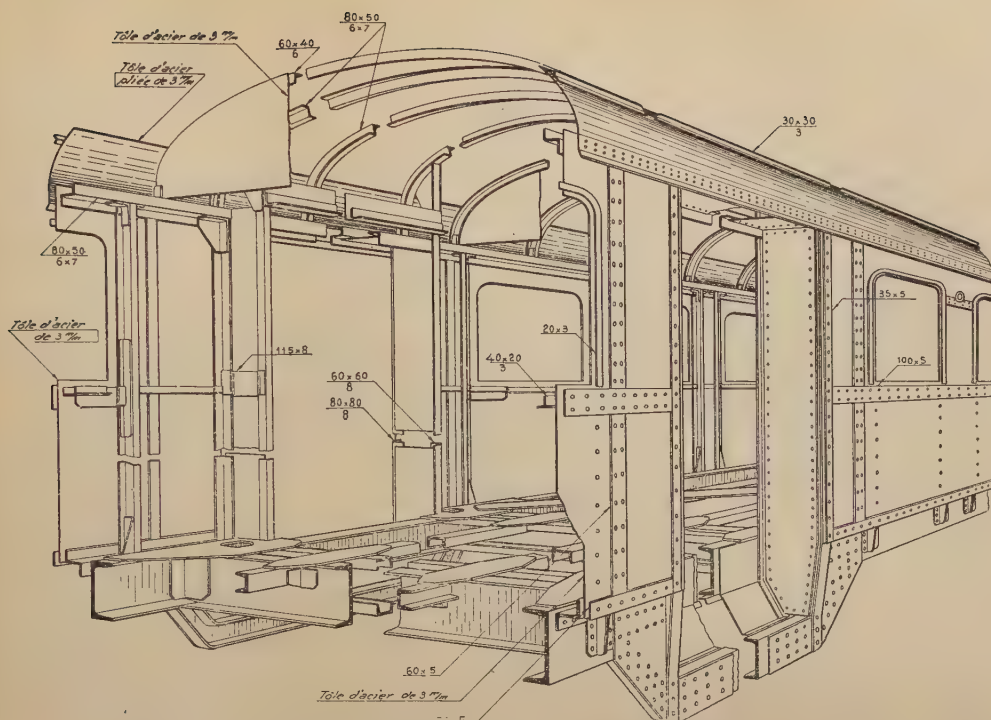
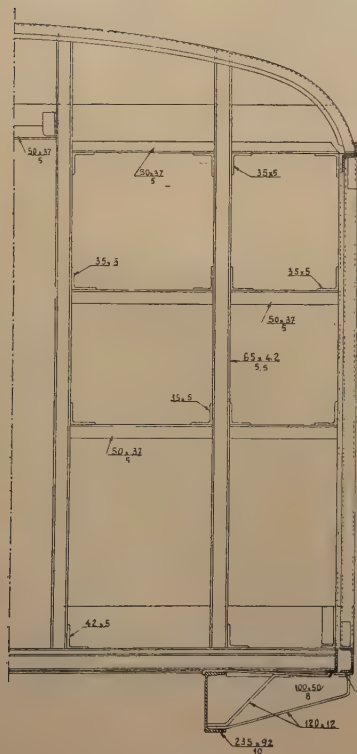
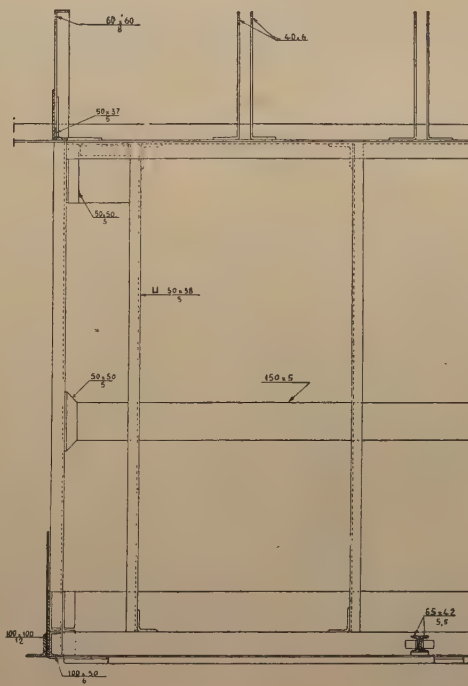


Fig. 25. — Nord-Milano Railway (Italy). — Metal carriages. — Body frame.



Cross section.



Elevation.

Fig. 26. — Prince Henri Railways (Luxembourg). — 6-wheeled 3rd class metal carriages. — Body frame.

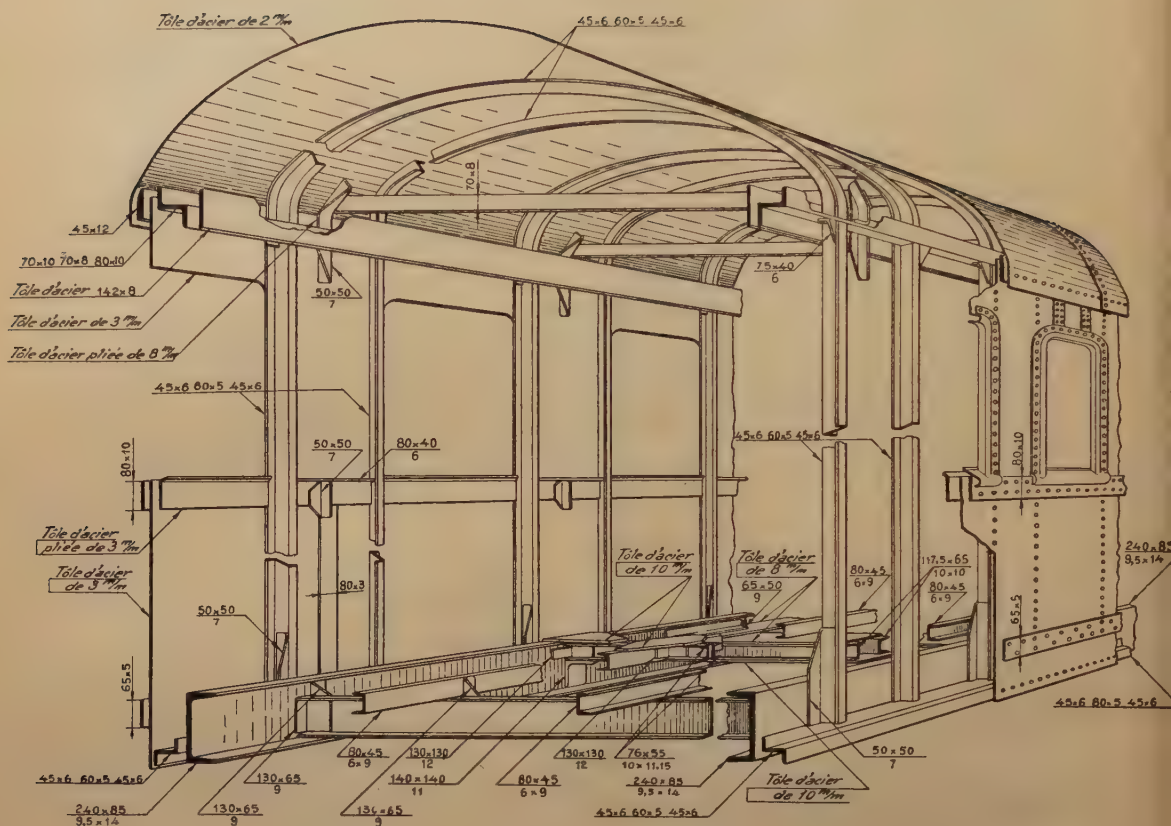


Fig. 27. — Polish State Railways. — Main line metal carriages. — Body frame.

disappear as regards the European Railways.

The following are some of the figures given by the Egyptian and Colonial Railways: on the Egyptian Railways the metal covered wagons form 99 % of the stock of covered wagons, and of the other sorts of wagons, very high percentages; on the lower Congo Railway, the all-metal wagon forms nearly the whole stock; on the Morocco Railways they form 50.8 %, and on the Lourenço Marquês, 46 %.

b) Types of wagons. — Construction.

— *Methods of construction and materials used.* — The diagrams given in Appendix VII show some types of all-metal wagons used on the Railways covered by the present report.

We have not taken into consideration the bogie flat wagons because these are always built in metal on all Railways.

These diagrams show that as regards the European Railways, most of them relate to high-sided four-wheeled or bogie wagons and in some cases flat four-wheeled wagons with drop sides.

The principle of construction is

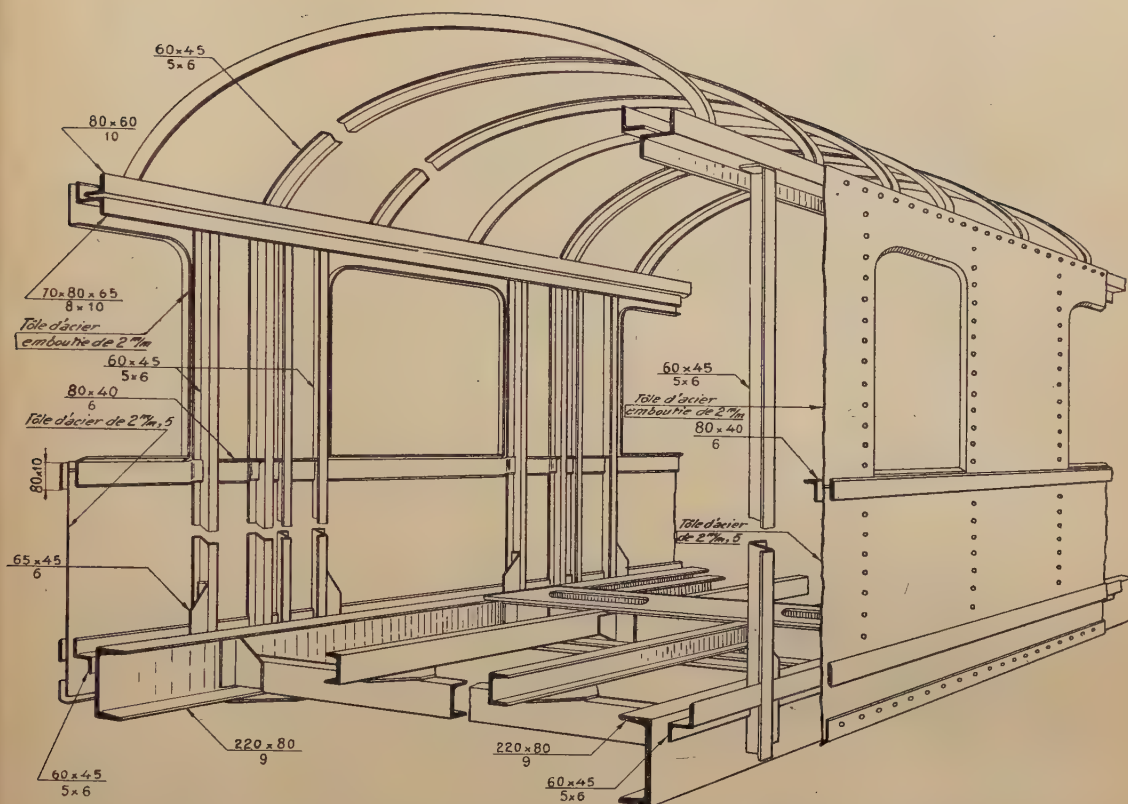


Fig. 28. — Swiss Federal Railways. — Main line metal carriages. — Body frame.

usually the same everywhere; both the underframe and the body have a framing built up of U, L, Z or rail section bars, and a panelling of plain sheet steel or steel pressings.

To prevent the frame deforming under violent shocks, the general method used has been to make the ends into very strong box girders by means of large plates placed above and below the frame; and as regards the body, an endeavour has been made to obtain a frame that will keep its shape by taking particular care as regards the joints of the parts forming the body framing.

A quite special form of construction is that used on the French Nord Rail-

way for some recent twenty-ton high-sided wagons (diagram No. 13) and for some self-discharging eight-wheeled wagons, intended for the conveyance of fuel (diagram 14). In these wagons use has been made in the main frame and in the body, of bent or pressed plates without any framing. In the 20-ton wagons, the frame is formed of a series of rectangular box girders connected together on their lateral edges by spot welding, and by lengths are welded. The box girders are framed in by the headstocks and the sole bars; these are also formed of bent plates and secured to the box girders by spot welding.

As regards the materials, copper bear-

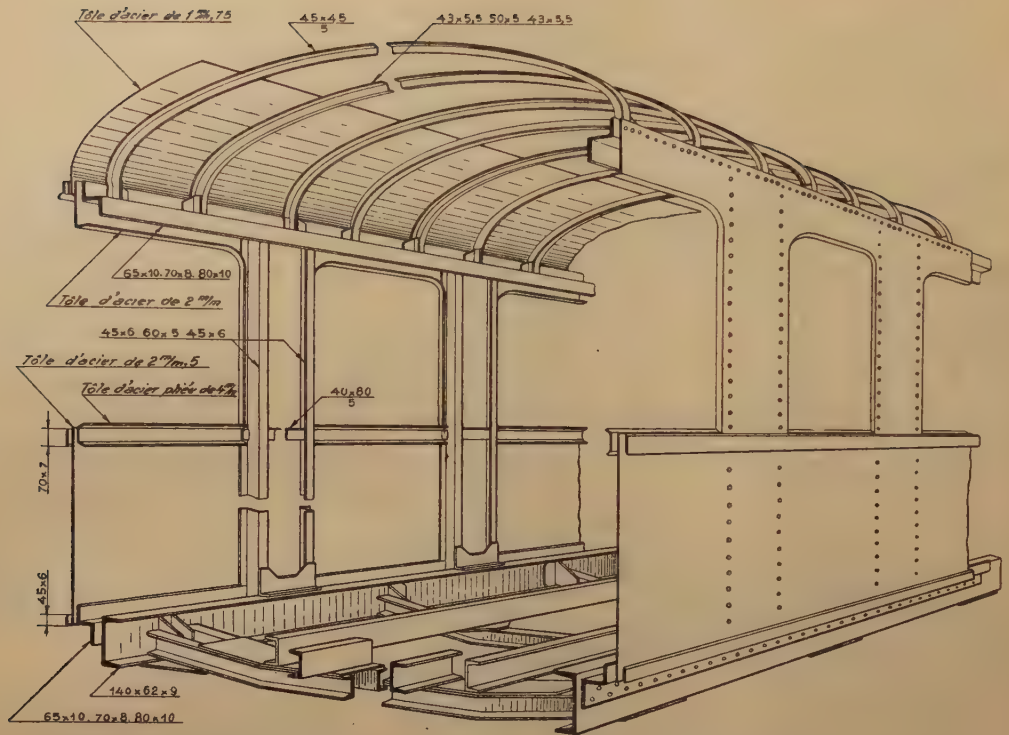


Fig. 29. — Rhätic Railway (Switzerland) (metre gauge). — Metal carriage. — Body frame.

ing steel is largely used at the present time for the rolled sections of the wagon framing, and for the plates and especially for these latter, as it has shown its superiority over ordinary steel as regards liability to rusting.

The Alsace-Lorraine Railways have also used, on a certain number of high-sided wagons, « Armco » iron for the soles, headstocks, and other frame members.

The different parts are in almost all cases rivetted together, welding only being used by the French Nord Railway for the said 20-ton high-sided wagons, and the 60-ton self-discharging wagons and by the Est Railway for some joints between the body and parts of the frame. It must however, be pointed out

that even in these wagons parts in cast steel and details which have to be easily replaced are rivetted or bolted together.

In order to protect the wagons against rusting, most of the Railways use iron oxide, red lead, or aluminium oxide paint, and linseed oil or graphitic base paint. The tests some Administrations have made with special anti-corrosive paints have given no better results.

The « Schoop » metallisation process, which consists in projecting by compressed air gun volatilised zinc has been used as a matter of trial on some wagons by the French Est Railway, and on a certain number of metal vehicles by the French State Railways. The results obtained have been completely satisfactory.

In the case of the Italian Railways, however, the process has not come into common use owing to its relatively high cost.

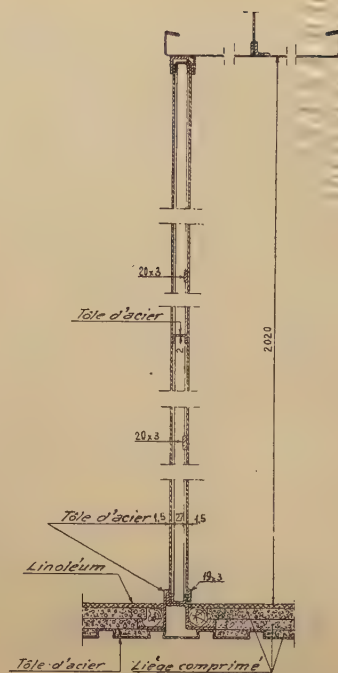
VI. — Use of welding in metal carriages and wagons.

Various Administrations who answered the questionnaire, have fully investigated the question of replacing riveting by welding in the erection of carriages and wagons. But with the exception of the French Est and the French Nord Railways which, as we have seen in the preceding paragraphs, have used welding as their usual method of welding, the other Railways either do not use it at all, or use it only for secondary joints, such as joining together the different plates of the body sides and as a method of keeping out water. For this purpose, welding is used to a considerable extent in the Italian State Railway vehicles.

All the different systems of welding in use today (continuous autogenous welding either by the flame or electric arc; electric welding on counter sunk holes, spot welding, butt welding) are used according to the case and according to the type of joint.

It is therefore difficult to say which method of welding is preferred at the present time, in the construction of railway vehicles; it appears however, that in the rolling stock we have had to consider, electric welding is the most widely used.

To avoid as far as possible deformations and warping near the weld, the arrangement shown to be the most effective with long and important welds, is that of carrying out the welding by short lengths separated by fairly considerable distances, the gaps left being welded up in the second stage; the welding is preceded by temporary erection on rigid formers. After welding any deformation and warping which occurs at times in spite of the above mentioned precau-



of Z-shaped partitions.
Fig. 30. — Vertical section

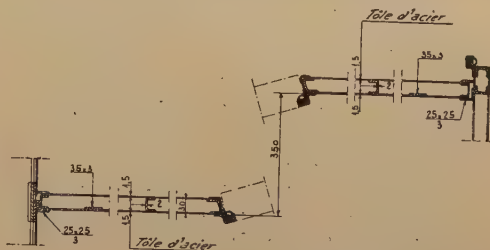


Fig. 31. — Horizontal section of Z-shaped partitions.

Figs. 30 and 31. — International Sleeping Car Company, — All-metal carriages.

tions are got rid of by reheating with the flame, on a small surface at a time, the deformed parts and allowing them to cool rapidly, while the defect is being made good with the hand hammer.

For parts not of great size, such as certain compartment doors built up by metal plates separated by stiffening pieces and welded together, the French Nord Railway has found it advisable to carry out the welding in water.

As regards the saving of weight to be realised by replacing riveting by welding, we have not received many accurate figures as on all the Administrations who commonly use welding and who in consequence would have the greatest experience, the use of welding was introduced at almost the same time as the metal construction. The French Nord Railway however, reports that it has saved a weight of 400 kgr. (885 lb.) in the case of the high-sided wagons of 8 500 kgr. (18 740 lb.) tare weight, and the Belgian Railways 800 kgr. (1 760 lb.) in the case of wagons which weighed, when rivetted, 11 130 kgr. (24 530 lb.). In a four-wheeled wagon built for trial by the Italian State Railways, and with all joints welded, the reduction of weight was about 11 %.

Finally as regards the more general use of autogenous welding, the French Est and Nord Railways which, as we have repeated several times, have made more progress in the art of welding, are of opinion it would be advisable to make its use more general as welding gives better and stronger joints, because they avoid the damage to the paint and the subsequent corrosion which occurs usually at the joints and at the rivet heads.

The other Administrations generally admit that in principle the replacement of riveting by welding can be done without drawbacks in most joints, except for the joints of parts which are frequently replaced; it appears, however that they still prefer riveting whilst waiting for a much longer experience of the use of welding to confirm the technical and economical advantages expected of it.

It is however certain that, just as the French Railways say, the question of the

general use of welding is closely connected with the problem of the possibility of providing at the different works suitable equipment for the new method of manufacture, and that it is subordinated to the condition that the detail parts of the vehicles in their form and in the way of making the joints be made to suit this new method.

In Appendix V will be found a summary of the information received from the different Administrations included in the present report, on the different questions concerning the use of welding in the assembly of metal carriages and wagons.

Summary.

To sum up our report it appears that as regards the Railways dealt with therein, the following conclusions can be drawn :

— The superiority of metal vehicles over vehicles with wood bodies has been universally recognised owing to the advantages that they present especially from the point of view of safety and the reduction of the costs of maintenance and of the amortisation charges. Metal construction has been definitely adopted by all the principal railways for all new vehicles, or at least for the bogie vehicles.

— The advisability when constructing metal vehicles, of making the body take a share in the load, by adopting either the tubular girder or the trellis girder or a system resulting from the combination of the two has been recognised universally.

— The trials that have been made of rebuilding in metal old vehicles with wood bodies has given satisfactory results, even if in this case it has not been possible always to follow exactly one of the above mentioned methods.

— The most remarkable items of progress we have observed in the most recent metal coaches from the point of

view of their general characteristics, whether of the method of construction, or the materials used, are the following : increase in the general dimensions of the vehicle and the compartments; improvement in the structure of the body as regards the shock-resisting arrangements; extension of metal construction to the inside partitions, to the roof, to the ends, to the floor and to the inside linings of the body sides; improvement in the connection of the cross partitions with the body framing so that they can assist in an effective manner in cross bracing the body; realisation of outside surfaces which are sufficiently smooth even in the case in which the outside plates are secured by riveting by using counter sunk rivets, and by reducing to a minimum the exterior strap plates.

— Light metals and alloys are used largely, both for covering the body sides and the roof, and in the construction of various details; up to the present it has not been used in the principal parts of the body frame or of the main frame. Nonetheless the reduction of tare obtained from its use is already noteworthy.

— The parts in light metals are at present assembled almost exclusively by riveting. The rivets are made of common steel, or copper bearing steel, or of the same light metal as the parts assembled. It is necessary to take precautions as regards the surfaces in contact, as otherwise destructive corrosions take place.

— On the European Railways, all-metal construction has already attained

in the case of open wagons (flat and high-sided), a wide use owing to its superiority from the point of view of strength, maintenance, and the ratio between the load and the tare. On the other hand, in the case of covered wagons, the mixed construction (frame and body framing in metal, panels in wood), is preferred, because usually the heat insulation is thought to be better.

— The system of construction preferred for the metal wagons up to the present is the one using a framing of rolled sections rivetted together; the trials carried out by several railway companies in order to use nothing but pressings or bent plates assembled by welding appear destined to have a practical success.

— The material which up to the present is most commonly used in the construction of metal wagons and which has shown itself to possess great resistance to rusting is copper-bearing steel.

With this material especially it has not been found necessary to use any special processes of protection against rust, such as the method of spraying zinc.

Autogenous welding as a method of assembling the members of the coaches and wagons has only come into general use on one or two railways. However, its use in place of riveting, in the less important joints, becomes more general day by day and investigations as well as tests for a still wider use of welding are being carried out everywhere very actively.

Florence, 1932.

Table summarising the replies from the various Administrations and their decision as regards the use of all-metal carriages.

Note. — The railways not mentioned in the table have either not supplied information or have not decided.

Country.	Railway.	Adoption of the all-metal construction for the new carriages.	Reasons deciding the adoption of the all-metal construction for the new carriages.	Number and percentage of all-metal carriages in service at the 1st January 1932.
1	2	3	4	5
Belgium	Belgian National Railway Company.	For all new carriages.	Greater safety for the passengers.	38 (1) 0.33 %
Belgium. (Colonies).	Lower Congo to Katanga.	Wood construction is preferred as giving better insulation against heat, being more easily repaired on the site and lighter.	...	...
Egypt.	State	For all new carriages.	Greater strength and cheaper to maintain.	326 20.5 %
Spain.	North of Spain	For standard Spanish gauge bogie carriages and brake vans only.	Greater safety for the passengers.	96 5 %
	West of Spain	For part of the new carriages only.	No experience yet as to the advantages and the drawbacks of metal carriages in Spain.	None.
France.	State	For all new carriages.	Greater rigidity of the whole vehicle and therefore a great saving in maintenance; greater safety and greater comfort.	1266 17 %
	Alsace-Lorraine	For all new carriages.	Greater safety for the passengers; a greater saving in maintenance.	65 1.9 %
	Est	For all new carriages.	Greater safety for the passengers.	76 2 %
	Midi	For all new carriages.	Heavier stock for high speed trains; greater uniformity of the stock; greater strength; less risk of fire.	200 9 %
	Nord	For all new carriages.	Greater safety for the passengers; greater comfort; longer life.	412 8.1 %
	Paris-Orléans	For passenger carriages for express and suburban trains only.	Greater safety for the passengers; greater comfort.	206 5 %

(1) Includes 26 Post Office carriages.

(2) Post Office vans are not included in these figures.

(3) These figures have been taken from the reports presented at the Madrid Congress in 1930.

connection with the growth of their stock of metal carriages
etal construction for carriages to be built.

y information or have reported that they possess no metal carriages.

1-metal carriages under construction the 1st January 1932.	Total all-metal carriages in service or under construction at the 1st January 1932.	The carriages given in column (6) divided according to the use made of them.		Number of all-metal carriages in service or on order before the year 1930. (³)	Progress of all-metal carriage construction from the point of view of the increase in the stock of these carriages. (Difference between columns 6 and 9).
		On the main lines.	On suburban lines or on secondary railways.		
6	7	8	9	10	11
None.	38	38	...	18	+ 20
...
None.	326	326	...	169	+ 157
None.	...	96	...	48	+ 48
28	28	28	...	...	+ 28
173	1439 (²)	700	739	529	+ 910
5	70 (²)	70	...	20	+ 50
164	240 (²)	140	100	20	+ 220
45	245 (²)	245	...	266	— 21
230	642 (²)	432	210	177	+ 465
20	226 (²)	30	196	180	+ 46

Country.	Railway.	Adoption of the all-metal construction for the new carriages.	Reasons deciding the adoption of the all-metal construction for the new carriages.	Number and percentage of all-metal carriages in service at the 1st January 1932.	
1	2	3	4	5	
France.	Paris - Lyons - Mediterranean (P. L. M.).	For all new carriages.	Greater safety for the passengers; greater comfort.	889	11 %
	Post Office	For all new post office carriages on the main line Companies.	...	462	51 %
Do. (Algeria and Tunisia)	P. L. M. (Algerian Lines).	For the next carriages to be acquired.	...	...	...
Do. (Protectorates).	Morocco	Wood construction is preferred owing to the heat and maritime humidity.	...	...	...
Italy.	State	For all new carriages.	Greater rigidity of the whole vehicle hence greater comfort and greater economy of maintenance; greater strength therefore greater safety for the passengers; less risk of fire; longer life; eliminates difficulties of obtaining supplies of wood.	1942	23.7 %
	Nord-Milano	For all new carriages.	Greater strength; greater saving in upkeep.	28	8 %
	Società Trazione Elettrica Lombarda.	For all new carriages.	Greater strength; longer life; greater saving in maintenance.	22	
Luxemburg.	Prince Henri	For all new carriages.	Greater strength; longer life; greater saving in cost of maintenance.	22	16.8 %
Poland.	State	For all new carriages.	Greater strength and greater uniformity of construction.	538	5 %
			Greater safety.	120 Post Office vans.	80 %
Portugal (Colonies).	Lourenço Marquês Port and Railway	For all new carriages.			
Switzerland.	Federal	For all new carriages.	Greater strength; greater safety for the passengers; greater saving of upkeep.	242	7 %
	Rhætic (metre gauge) .	Awaits the results shown by the metal carriages in service.	Greater safety for the passengers; greater saving in maintenance.	25	12.6 %
Jugoslavia.	State	For all new carriages.	Greater strength; longer life; greater saving in maintenance.	85	4 %

(2) Post Office vans are not included in these figures.

(3) These figures have been taken from the reports presented at the Madrid Congress in 1930.

APPENDIX N° I (Continued)

All-metal carriages under construction at the 1st January 1932.	Total all-metal carriages in service or under construction at the 1st January 1932.	The carriages given in column (6) divided according to the use made of them.		Number of all-metal carriages in service or on order before the year 1930. (³)	Progress of all-metal carriage construction from the point of view of the increase in the stock of these carriages. (Difference between columns 6 and 9).
		On the main lines.	On suburban lines or on secondary railways.		
6	7	8	9	10	11
18	907 (²)	889	18	380	+ 527
119	581	581	...	177	+ 404
...
...
962	2904	2904	...	1300	+ 1604
4	32	...	32	...	+ 32
4	26	...	26	...	+ 26
5	22	22	...	...	+ 22
10	668	668	...	10	+ 658
Post Office vans.	...	...	...	...	...
138	380	380	...	24	+ 356
None.	25	...	25	...	+ 25
30	115	115	...	...	+ 115

APPENDICES II to V.

The information supplied by the various Administrations has been summarised under the following headings.

APPENDIX II.

Principal features of the all-metal carriages in service, under construction or being designed, other than those mentioned in 1930 at Madrid.

(Passenger carriages, passenger brakes, and Post Office carriages only included. Luggage brake vans have not been considered.)

- a) *Services in which the carriages are used, classes of carriages.*
- b) *Type of construction adopted.*
- c) *Materials used for the :*
 - 1) *Principal frame members;*
 - 2) *Principal body members;*
 - 3) *Principal parts of the bogie frames;*
 - 4) *Outside lining of body sides;*
 - 5) *Inside lining of body sides;*
 - 6) *Partitions;*
 - 7) *Flooring;*
 - 8) *Roof.*
- d) *Methods used for the heat insulation of the :*
 - 1) *Floor;*
 - 2) *Body sides;*
 - 3) *Roof.*
- e) *Methods of erection used.*
- f) *Some of the particular differences in construction as compared with the first metal carriages built.*

The summarised replies and the particulars taken from the drawings sent will be found on pages 1876 to 1888.

APPENDIX III.

The use of light metals or alloys in the construction of metal carriages.

- a) *Class of carriages in which light metals or alloys have been used.*
- b) *Parts playing a part in the strength of the frame or of the body, made in light metals or light alloys.*
- c) *Principal parts of the inside and outside linings, interior partitions, interior fittings and decorations, in light metals or alloys; description of these parts : metal or alloy used.*
- d) *Methods used in making joints of parts in light metals or alloys.*
- e) *Precautions taken to prevent corrosion between the surfaces in contact with other metals.*
- f) *Saving in weight obtained by using light metals or alloys.*
- g) *Increase in cost resulting from the use of light metals or alloys.*

The replies of the Administrations in respect to Appendix III will be found on pages 1889 to 1891.

APPENDIX IV.

All-metal construction of covered and open wagons used for general goods as well as for coal, coke, and mineral traffic.

- a) *Intention to adopt the all-metal construction ⁽¹⁾ for new wagons to be built. Use of the all-metal construction in wagons in service.*
— *Reasons for deciding to use metal, or composite, or wood construction.*
- b) *Leading features of the all-metal construction adopted.*
Diagrams of the all-metal wagons in service.
- c) *Percentages of all-metal wagons for each of the classes given below, in service on the 1st January 1932 :*
 - 1) *Covered.*
 - 2) *Flat ⁽²⁾.*
 - 3) *High-sided.*
- c) *Percentages of all-metal wagons for each of the classes given below, in service on the classes given below in service on the 1st January 1932 :*
 - 1) *Covered.*
 - 2) *Flat ⁽²⁾.*
 - 3) *High-sided.*
- e) *Constructional materials used for the principal parts of the all-metal wagons or of those with all-metal underframes and body framing.*
- f) *Methods adopted to prevent corrosion.*
- g) *Arrangements adopted in the all-metal covered wagons for heat insulation and against condensation.*
- h) *Methods of making the joints between the metal parts.*

The replies will be found on pages 1892 to 1897.

APPENDIX V.

The use of welding for the joints of the different parts of the body, of the frame, and of the bogies, of metal carriages and wagons.

- a) *Kind of vehicle on which welding is used — description of joints made by welding.*
- b) *System of welding used.*
- c) *Precautions taken to prevent deformation and warping of the plates near the weld.*
- d) *Reduction in weight obtained by welding joints instead of riveting them.*
- e) *Opinion upon making welding general in place of riveting.*

The replies of the Administrations are given on pages 1898 to 1901.

⁽¹⁾ Metal wagons with wood floors are considered as being all-metal wagons.

⁽²⁾ Low-sided wagons are included amongst the flat wagons.

Replies of the Administrations.

Belgian National Railway Company.

- a) For all lines. — Bogie carriages and carriage brakes 22 m. (72 ft. 2 in.) long with end doors only, and bogie carriages and carriage brakes 18 m. (59 ft. 5/8 in.) long with side doors.
- b) The frame and body form one structure with the *body framing of rolled sections* (figs. 1-2).
- c) 1) *Rolled steel U bars* for the sole bars and headstocks: *standard rolled sections* for the other frame members. Cast steel for brackets carrying equipment such as for example the brake gear.
- c) 2) *Steel Z bars* for the body pillars. *Steel pressings* for the end pillars forming the anti-telescopic device. *Steel pressings* for the rails connecting the pillars and round the openings. *Steel angles* for the cant rail, for the roof framing, and in the carriages with side doors, for the body side diagonal braces. *Cast steel* for connections. Certain rolled sections are made to work in by planing or by forging.
See figs. 1 and 2.
- c) 3) *Standard rolled steel bars*. The use of pressings for the bogie centre bolster, the bolsters, and the side frames is under consideration.
- c) 4) *Steel plate* 2.5 mm. (0.098 inch) thick.
- c) 5) *Wood paneling or aluminium sheet panels* in wood frames and covered in fabric or (in the 3rd class) sheet steel panels painted and framed in wood.
- c) 6) Cross partitions: *steel plates* secured to a framing of *rolled sections* or *bent plates*. The plates are painted or covered with fabric framed in wood mouldings, hiding the metal uprights and rails of the partitions, or are covered with wood paneling. Wood for the longitudinal partitions.
- c) 7) *Galvanised corrugated steel plate* on which is spread a layer of *magnesia cement* mixed with wood sawdust (*terrazolith*).
- c) 8) *Steel plate* 1.5 mm. (0.059 inch) thick on the outside and *sheet aluminium* 1 mm. (0.039 inch) thick covered with fabric on the inside.
- d) 1) The heat insulation is provided by the *terrazolith* laid on the galvanised corrugated plating.
- d) 2) The insulation is provided by a layer of insulating material consisting of *cork* or of *wood fibre* or of *cane* 10 to 12 mm. (3/8 to 1/2 inch) thick, glued to the panels forming the inner lining. The space between the outer and the inside lining is ventilated to assure the rapid evaporation of condensed moisture.
- d) 3) The same arrangement as for the body sides.
- e) *Riveting*. Electric welding is only used at places where riveting is impossible or too difficult.
See also Appendix VI.

West of Spain Railway.

- a) For the main lines. — Bogie coaches of classes AWFHV, AAWFHV, ABWFHV and CWFHV.
- b) The frame and body form one unit, the body framing consisting of *rolled bars*, *bent plates* and *pressings* (fig. 3). When deciding upon the method of construction an endeavour was made to use existing industrial equipment. The creation of a specialised national industry would not be justified.
- c) 1) *Steel U bars* for the soles and headstocks; *standard steel rolled bars* for the other members; *cast steel* for the body bolsters. See fig. 3.
- c) 2) *Bent steel plates* for the pillars and for the rails connecting the uprights; *steel angles* for the cant rail; *steel pressings* and *angles* for the roof framing. See fig. 3.
- c) 3) *Cast steel*.
- c) 4) *Copper steel plate* 3 mm. (1/8 inch) thick.

The plate is pressed from the waist rail to the top of the windows.

c)5) Chiefly *wood* with plywood panels in the 1st and 2nd classes. Principally *steel plate* in the 3rd class.

c)6) *Steel plate* covered with wood panels in 1st and 2nd classes. *Steel plates* 2 mm. (5/64 inch) thick stiffened by small pressings in the 3rd class.

c)7) Corrugated *steel plates* 1.5 mm. (0.059 inch) thick covered with cork, linoleum, and in the 1st class a carpet.

c)8) On the outside, *copper steel plate* 1.9 mm. (0.075 inch) thick; inside, *plywood panels* in the 1st and 2nd classes; 2-mm. (5/64 inch) *steel plate* in the 3rd class.

d)1) The heat insulation is obtained by means of the *cork* laid in the corrugated plating.

d)2) The heat insulation is got by the *air space* between the inner and outer linings and by a 20 mm. (3/4 inch) thick layer of *Salamander felt*.

d)3) The heat insulation is assured by the *air space* between the inner and outer roof.

e) *Riveting*.

French State Railways.

a) For the main lines. — Bogie carriages of classes A⁸yi, A⁸c³yi, A³B⁵yi, A³cB⁵cyfi, B⁹yi, B⁴C⁵yi, B⁴cC⁵cyfi, C¹⁰yi, C⁵Dyfi, all of the O.C.E.M. design.

b) The body and frame form a single unit; the body framing of *rolled bars* rivetted together and excepting the ends covered with a relatively thin plate the principal function of which is to prevent deformation of the joints. At the ends, the outer sheeting is thicker and more stoutly secured so that it can itself stand up to violent shocks. Cross section, end platforms, and ends of frames, common to all the different classes of carriage. Large number of details are common in each carriage. (See fig. 5.)

c)1) *Rolled steel U bars* for the soles; head stocks built up from 10 mm. (3/8 inch) thick *steel plate* and two *angles*. *Rolled steel I bars* for the intermediate cross

bearers, *steel angles* for the intermediate longitudinals except at the ends where *steel rolled U bars* are used. *Cast steel* for the body bolster and for certain connections. See fig. 5.

c)2) *Steel Z bars* for the pillars; *steel angles* for the cant rails and for the framing of the roof itself. *Steel pressings* 6 mm. (15/64 inch) thick for the sides, *bent 6 mm. thick plate* for the body corner pillars. See fig. 5.

c)3) Built up of *steel castings* and *rolled bars*.

c)4) For the sides, *copper steel plate* 3 mm. (1/8 inch) thick secured to the framing by *steel flat bars* sufficiently thick for countersunk rivets to be used; this plate is stiffened by bent plates and by angles spot welded to it. For the ends the *same plate* is used as for side framing.

c)5) *Sheet steel* 1 mm. (3/64 inch) thick screwed to wood pattresses which are bolted to the framing. The plate is painted in the 3rd class; it is covered with *lincrusta* or *loreid* in the 2nd and 1st, and upholstered to the height of the top of the backs in the 1st class compartments.

c)6) *Sheet steel* 1.5 mm. (0.059 inch) thick for the corridor partitions and 1 mm. (3/64 inch) for the cross partitions rivetted to a light framing of angles. The cross partition plate is stiffened vertically at the middle by *two bent plates*. See fig. 6.

c)7) *Corrugated plate* 1 mm. (3/64 inch) thick covered with terrazolith and below it 3 mm. (1/8 inch) apart a *second plate* 1 mm. thick. The terrazolith flooring is left uncovered in the 3rd class; it is on the contrary covered with linoleum in the 2nd class, with linoleum and a carpet laid on a woven hair cloth in the 1st class. Both steel plates are galvanised.

c)8) On the outside *steel* or « *Armco iron* » plates 1.5 mm. (0.059 inch) thick, butt joints with joint straps rivetted together immediately over the carlines. Inside *steel plates* 0.5 mm. (0.0197 inch) thick arranged symmetrically to the centre line of the compartment and to that of the corridor,

- screwed to wood hoop sticks which in turn are themselves bolted to the metal carlines.
- d)1) The heat insulation is obtained by the *terrazolith* covering of the floor itself and the *layer of air* between the corrugated plating and the plate forming the under floor.
 - d)2) The heat insulation is obtained by the *layer of air* between the inside and outside linings and also by slabs of cork 10 mm. (3/8 inch) thick applied to both the outer and inner plates.
 - e) *Riveting* in the main members; welding only being used for assembling secondary parts and for assembling the different plates of the outside lining.
 - f) The interior partitions are built with a single partition instead of double. In the construction of the partition itself the bent plates, and all the rather complicated castings, used in joining them together made use of in the first metal coaches have been suppressed. The outer lining is secured with countersunk rivets. Ends made of a single pressed plate of considerable thickness in place of a framing of bent plates and rolled sections covered with relatively thin plates.
 - c)3) Built up of *cast steel* parts and *steel sections*.
 - c)4) *Steel plate* 3 mm. (1/8 inch) thick. The plate is stiffened by horizontal bent plates.
 - c)5) *Steel plate* 1.5 mm. (0.059 inch) thick in the upper part; two steel plates, one 2 mm. (5/64 inch) thick and the other 0.8 mm. (0.031 inch) with a layer of felt in between them in the lower part.
 - c)6) *Steel plate* 1.5 mm. (0.059 inch) thick fastened to a framing of 3 mm. (1/8 inch) thick steel plate and L bars. The plates are stiffened on their inside face by horizontal flat bars and bent plates. See fig. 7.
 - c)7) *Corrugated steel plate* 1.5 mm. (0.059 inch) thick covered with compressed cork, *linoleum* and a *carpet*.
 - c)8) Outside: Steel plates 1.5 mm. thick, butt strap joints over the carlines. Inside: steel plates 1.5 mm. thick rivetted to a light framing of rolled L bars.
 - d)1) The heat insulation is obtained by means of the *compressed cork* laid on the corrugated plating.
 - d)2) The heat insulation is obtained by a *layer of air* between the inner and outer linings, and by the *slabs of compressed cork* 10 to 15 mm. (3/8 inch) thick applied to the internal faces of the outside and inner linings. The slabs of cork are held by wires electrically spot welded to the plate, the ends of the wires being bent over a flat washer.
 - e) Riveting. Welding is only used to assemble secondary parts.

French State Railways.

(Continued.)

- a) Main lines. — Bogie carriages of classes A⁴yfi and A²syfi of the O.C.E.M. and State designs.
- b) The frame and body form a single unit with a *body framing of rolled sections and bent plates and pressings* assembled by riveting and covered with a relatively thin plate.
- c)1) *Steel U bars* for the soles and head stocks; *steel U and L bars* for the intermediate longitudinals, *steel T and I bars* for the intermediate cross bearers; *cast steel* for the body bolsters and for some constructional details.
- c)2) *Steel Z bars* for the body pillars; *bent plates* 6 mm. (1/4 inch) thick for the end and corner pillars; *steel angles* for the cant rail; *steel pressings* for the carlines; *steel angles* for the roof framing.
- a) Suburban lines. — Bogie carriages of classes A²vfo, B³yfo, C³vfo, A²B²yfp, B²Eyfp, C²Evp. all of O.C.E.M. design.
- b) The frame and body form a single unit; the *body framing in rolled sections and bent and pressed plates*, rivetted together, covered by sheeting of relatively small thickness. See fig. 8.
- c)1) *Steel U bars* for the soles and head stocks; *steel Z, L and U bars* for the longitudinals and intermediate cross bearers, *cast steel* for the body bolsters. See fig. 8.

French State Railways.

(Continued.)

- c)2) *Steel Z bars* for pillars; *steel angles* for cant rails and roof framing; *bent plate* 6 mm. (1/4 inch) thick for the end and corner pillars. The side pillars are fastened to the sole bars by *cast steel brackets*. The side door pillars and the roof cant rails above them are reinforced by being built up of *plain sheets* and *angles*. See fig. 8.
- c)3) Built up of *steel castings* and *steel sections*.
- c)4) *Steel plate* 3 mm. (1/8 inch) thick attached to the framing by butt joints with visible head rivets. The plate is stiffened by horizontal bent plates.
- c)5) *Duralumin plate* 1.3 mm. (0.051 inch) thick screwed to wood pattresses with strapped butt joints. The pattresses are bolted to the metal framing.
- c)6) *Steel plate* 2 mm. (5/64 inch) thick fastened to a light framing in L bars and flat bars. The partitions are double. See fig. 9.
- c)7) Corrugated steel plate 1 mm. (3/64 inch) thick covered with terrazolith. The plate is galvanised.
- c)8) Outside; *duralumin plate* 2 mm. (5/64 inch) thick strapped butt joints at the carlines. Above the vestibules the thickness of the plate is 3 mm. (1/8 inch). Inside: *semi-hard aluminium sheet* 1.3 mm. (0.051 inch) thick, screwed to wood pattresses bolted to the metal carlines.
- d)1) The heat insulation is obtained solely by means of the *terrazolith* floor covering.
- d)2) The heat insulation is obtained solely by the *layer of air* between the inner and outer linings.
- d)3) As for the sides and ends.
- e) *Riveting*. The heads of the rivets are left visible. Welding is only used for assembling secondary parts.

French State Railways.
(Continued.)

- a) Suburban lines. — Bogie carriages classes, ZABEyp and 1/2ZByfp, State design.
- b) The frame and body form a single unit with the body framing of *rolled sections* assembled by riveting and covered with thin plate. See fig. 10.
- c)1) *Steel U bars* connected by a 5-mm. (3/16 inch) thick plate with lightening holes for the soles; *steel castings* joined together by a 10 mm. (3/8 inch) thick plate and by *steel U bars* for the head stocks; *steel U bars* for the intermediate longitudinal; *steel pressings* 8 mm. (5/16 inch) thick for the intermediate cross bearers; *steel flats* for the St. Andrew's crosses; *steel pressings* joined by *steel castings* for the body bolsters. See figs. 10 and 11.
- c)2) Rectangular frames of *steel U bars* joined to the frame and cant rail by *steel castings* replace the ordinary pillars; girders built up of a *steel U bar*, *two angles* and *steel plate* 3 mm. (1/8 inch) thick for the cant rail; *steel pressings* for the window pillars; *steel I and U bars* for the roof framing. See fig. 10.
- c)3) *Steel castings* and *rolled steel sections*.
- c)4) *Steel plate* 2 mm. (5/64 inch) thick directly fastened to the frame with visible head rivets.
- c)5) *Steel plate* 2 mm. thick fixed to the framing with 3 mm. (1/8 inch) thick flat bars to enable countersunk rivets to be used.
- c)6) *Steel plate* 2 mm. thick riveted to a framing of bent plate, L bars and flats.
- c)7) Corrugated steel plate 1.25 mm. (0.049 inch) thick covered with *terrazolith*.
- c)8) Outside: *steel plate* 1.5 mm. (0.059 inch) thick strapped butt joints at the carlines and rivetted. Inside: millboard screwed to flat bars.
- d)1) The heat insulation is obtained by the *terrazolith* floor covering.
- d)2) The heat insulation is obtained by the *layer of air* between the inside and outside linings and in addition by slabs of *compressed cork* 15 mm. (5/8 inch) thick fixed by wires spot welded to the outside lining, the ends of the wires being bent over sheet washers.
- d)3) The same arrangement as for the body and sides.
- e) *Riveting*, visible heads. Welding only used for joining up secondary parts.

French State Railways.*(Continued.)*

- a) Suburban lines. — Bogie carriages of classes A²Byfi, Cyfi and CEyfi, of State type (carriages being designed).

Alsace-Lorraine Railways.

- a) Main lines. — Bogie carriages classes A⁸yfi, C⁹yfi, of O.C.E.M. design. The same general characteristics as the O.C.E.M. designs used on the main lines of the State Railways.

French Est Railway.

- a) Main lines. Bogie carriages. Caisses A³1/2B⁵yfi, A³B⁴E²yfi, and C⁵Dyi.
 b) The frame and body are in one unit and form a « tubular girder ». The girder has a web and two flanges. The web is represented by the two sides together; the upper flange by the roof; the lower flange by a general flooring in plate tied to the two longitudinals. *Steel pressings* are largely used. See fig. 13.
 c)1) *Steel pressings*. Cast steel for certain connections too complicated to make in pressings. See fig. 13.
 c)2) *Steel pressings*. See fig. 13.
 c)3) *Cast steel*.
 c)4) The same plates as those constituting the framing of the body. The outside plates are rivetted, countersunk rivets being used.
 c)5) 1st, and 2nd classes, *plywood panels* covered with *leather cloth*, 3rd class painted *plywood panels* in the compartments; *vitreous enameled plates* and *smooth plates painted* in the corridors and vestibules. The inside panels are screwed onto wood pattresses fastened to the framing by means of welded plate angles and coach screws.
 c)6) *Steel plates* stiffened by means of small bent plates and covered according to class by panels of *plywood*, by *painted* or *vitreous enamelled smooth plates*. See figs. 14 and 15.
 c)7) A wood frame carrying the flooring boards, flannellette being inserted between the framing and the boards, the whole

supported by the steel frame. According to class a *carpet* or *linoleum* is laid on the floor boards.

- c)8) Outside: *steel plate* 2 mm. (5/64 inch) thick, with *plywood wood panels* carried on wood pattresses secured to the roof framing, flannellette being incerted between the panels and the pattresses.
 d)1) The heat insulation is obtained by the *layer of air* between the frame plating and the thick wood floor.
 d)2) The heat insulation is obtained by the *layer of air* between the inside and outside linings.
 d)3) The heat insulation is obtained by the *layer of air* between the outer and inner roof and by *slabs of compressed cork* 10 mm. (3/8 inch) thick glued to the inside of the roof with zinc white and secured by wires turned over washers.
 e) *Riveting* exclusively in the frame; *riveting and welding* in the body. See also Appendix VI.
 f) The soles and headstocks and the cant rails were in the first vehicles of standard and special rolled sections. At present pressings are used instead.

French Est Railway.*(Continued.)*

- a) Suburban lines. — Bogie carriages of classes Axxy, Bxxy, Cxxy, CDxxy. Same general characteristics as the main line stock.

French Midi Railway.

- a) Main lines. — Bogie composite 1st and 2nd classes, and 3rd class carriages. These carriages are to the O.C.E.M. standard design.

French Nord Railway.

- a) Suburban lines. — Bogie carriages classes Ayi, ABYi, BDYi, CYi, CDSYi.
 b) The frame and the body are in one and form a « tubular girder ». See fig. 16.

- c)1) *Pressed and bent steel plate* for the soles and intermediate longitudinals; *pressed and bent steel plate and T bars* for the intermediate cross bearers. *Cast steel* for the frame end castings, for the draw and buffing gear and for the brackets. See fig. 16.
- c)2) *Steel pressings* 4 mm. (5/32 inch) thick for the body sides and 3 mm. (1/8 inch) thick for the ends; *steel T bars* for the transverse rings forming the reinforcement of the body; *bent steel plate* for the cant rail; carlines built up of *two steel T bars and web of steel plate*. The outside plates are generally secured by spot welding. See fig. 16.
- c)3) *Cast steel*.
- c)4) The same *plate* as that used for the body framing.
- c)5) *Aluminium plate* 1.5 mm. (0.059 inch) thick.
- c)6) *Two pressed steel plates* 3 mm. (1/8 inch) thick separated by the *bent plate* pillars. See fig. 17.
- c)7) *Corrugated steel plate* galvanised, 1.5 mm. (0.059 inch) thick covered with *terra-zolith*.
- c)8) Outside: 3 mm. (1/8 inch) thick *steel plate*. Inside: *aluminium plate* 1.5 mm. (0.059 inch) thick.
- d)1) The heat insulation is obtained by the *layer of terrazolith*.
- d)2) The heat insulation is obtained by the *layer of air* between the inner and outer linings and by blocks of compressed cork 10 mm. (3/8 inch) thick secured to the inner faces of the outer sheeting and of the inside lining.
- d)3) The same arrangement as for the body and sides.
- e) The chassis, riveting only; the body, large use of welding by all the welding methods used in the industry. See also Appendix VI.

Paris- Lyons and Mediterranean Railway.

- a) Main lines. — Bogie carriages of class A³c²L³g³yfi.
- b) The frame and body form one single unit but do not exactly form a box girder as in these carriages, which are the result of

rebuilding wood-bodied stock, existing parts were used as much as possible. The inside partitions were retained as was the exterior sheeting of 1.5 mm. (0.059 inch) thick *steel plate* which did not play any part in the strength of the body. See fig. 18.

- c)1) *Steel plate* 6 mm. (1/4 inch) thick reinforced by *angles* for the soles (this plate is the same plate as forms the lower part of the body sides).
- Steel U bars* for the headstocks, *steel plate* 10 mm. (3/8 inch) thick reinforced by *angles* for the frame ends. *Steel U bars* for the intermediate cross bearers and for the body bolster. *Steel L bars* for the intermediate longitudinals and for the St. Andrew's cross bracing. See figs. 18 and 19.
- c)2) *Steel plate* 6 mm. (1/4 inch) thick up to the waist rail; *steel U and L bars* for the pillars; *steel angles* for the cant rail; *rolled T and L bars* for the roof framing except at the ends over the vestibules where *pressings* are used. *Copper steel plate* 7 mm. (9/32 inch) thick for the body ends. All the rolled sections are standard. See figs. 18 and 19.
- c)3) *Cast steel*.
- c)4) Body sides: *copper steel plates* 1.5 mm. (0.059 inch) thick in the form of panels screwed on to wood framing. Body ends: the same plate as the sides.
- c)5) *Wood linings*.
- c)6) *Wood panels* on wood framing. The partitions of the vestibules and end lavatories are reinforced by *steel plates* and *rolled sections*.
- c)7) *Corrugated copper steel galvanised plate* 1.5 mm. (0.059 inch) thick on which are applied two layers of « *liégolithe* ». On the second layer, a carpet is laid.
- c)8) Outside: *copper steel plate* 2 mm. (5/64 inch) thick butt strap joints above the carlines and rivetted thereto. Inside *steel plate* 1 mm. (3/64 inch) thick screwed on to wood framing.
- d)1) The heat insulation is obtained by the two layers of « *liégolithe* ».
- d)2) The heat insulation is obtained by *layers of air* between the inner and outer sheeting.

- d)3) The heat insulation is obtained by the layer of air between the inner and outer roof and by slabs of compressed cork 10 mm. (3/8 inch) thick packed in between the inner and outer roofing.
- e) Riveting.

Paris-Orleans Railway.

- a) For the main lines. — Bogie carriages classes A^{3 1/2}B⁵yfi (O.C.E.M. design). Same general characteristics as the main line coaches of O.C.E.M. design of the French State Railways with some modifications as regards the nature of the materials used in their construction, such as: *monobloc steel castings* for the bogie frames, « *Armco* » iron for the outside roofing; « *feutrisol* » mattresses for the heat insulation of the body sides and roof.

Paris-Orleans Railway.

(Continued.)

- a) Suburban lines. — Bogie carriages class C⁹Pyfp (O.C.E.M. design). The same general characteristics as the O.C.E.M. design suburban carriages of the French State Railways with, however, some modifications as regards the constructional materials used such as: *monobloc steel castings* for the bogie frames; « *feutrisol* » mattresses for the heat insulation of the body sides and roof; « *duralumin* » plate 1 mm. (3/64 inch) thick for the inner roof.

French Main Line Railway Systems.

- a) Post Office carriages, classes PAYi, Patf, PAy, Patyf (O.C.E.M. design). The same general characteristics as carriages to the O.C.E.M. designs for the main lines.

Italian State Railways.

- a) Main lines. — Bogie carriages classes Az-Bz-Cz.
- b) The frame and body form one unit as it were a *box girder* in which the outside sheeting of the body sides plays an essential part in the strength of the unit. See fig. 20.

- c)1) *Steel U bars* for the soles, head stocks, intermediate cross bearers and longitudinals; girder built up of two *steel U bars* and two *steel plates* 10 mm. (3/8 inch) thick for the body bolster.

Steel plates 10 mm. (3/8 inch) thick at the frame ends to reinforce the connections. All the rolled sections are standard. See fig. 20.

- c)2) *Copper steel plate* 4 mm. (5/32 inch) thick except for the ends where it is 3 mm. (1/8 inch) thick; *bent copper steel plate* 6 mm. (1/4 inch) thick for the angle pillars; *steel U and L bars* for the other pillars; *copper steel bent plate* 4 mm. (5/32 inch) thick for the cant rail; *steel L bars* for the carlines; *vertical steel plates* 3 mm. (1/8 inch) thick for the cross bracing of the roof. See fig. 20.

- c)3) *Steel pressings* and *steel U bars*.

- c)4) The same plate as that used for the body framing. The plate is rivetted to the soles, to the headstocks and to the body pillars with countersunk rivets.

- c)5) *Aluminium sheet panels* screwed to a wood framework bolted to the metal framing. The aluminium panels are covered with *linoleum* in the 2nd and 3rd classes and with *pegamoid* in the 1st class.

- c)6) Longitudinal partitions, wood framing secured by a *steel plate* to the frame members and by an *aluminium plate bent into V form* to the roof cross bracing; *aluminium plate panels* 1 mm. (3/64 inch) thick covered with *linoleum* or *pegamoid*. For the cross partitions up to the tops of the seat backs: *aluminium plate* 2 mm. (5/64 inch) thick applied to a metal framing fastened to the body side, the corridor partition, and the floor. The lavatory partitions at the end of the body are all built up of 2 mm. thick *steel plate* entirely (anti-telescoping arrangement). See fig. 22.

- c)7) *Corrugated aluminium plate* 1.5 mm. (0.059 inch) thick covered with a layer of cork 40 mm. (1 9/16 inches) thick and a wood floor laid on a wood framing except under the seats where there is only an *aluminium plate* 1 mm. (3/64 inch) thick.

The wood floor is covered with a *rubber carpet* or *linoleum* and a *wool carpet* in the 1st class; with *rubber* or *linoleum* in the second and third classes.

- c)8) Outside: *aluminium plate* 2 mm. (5/64 inch) thick butt joints with steel strap plate over carlines. At roof ends steel plates 4 mm. (5/32 inch) thick (anti-telescoping arrangement). Inside: *aluminium plate* 1 mm. (3/64 inch) thick screwed on to wood pattresses bolted on to the metal carlines.
- d)1) The heat insulation is given by the layer of *compressed cork* on the corrugated sheeting.
- d)2) The heat insulation is given by a layer of *compressed cork* 55 mm. (2 3/16 inches) thick between the inner and outer body linings.
- d)3) The heat insulation is obtained by a layer of *air* and by slabs of compressed cork fastened to the outer plates by wood pattresses bolted to the metal carlines.
- e) *Riveting*. Welding is used for secondary work only and for joining together the plates forming the body sides and ends; in this case the welding is reinforced by flat bars rivetted to the plate.
- f) All the St. Andrew's cross bracings in the frame suppressed and replaced by wide plates. Simplification of the body framing. Use of metal construction for the top part of the corridor partition in place of wood framing. Large use of light metals in parts playing no part in the strength of the body.

Italian State Railways.

(Continued.)

- a) For all lines. Rebuilt bogie carriages, class Cz.
- b) The body is solidly fastened to the frame but does not form a single unit with it as these carriages have been rebuilt from old wood carriages the frames of which have been retained. Consequently the soles are fitted with tie rods. See fig. 23.
- c)1) *Steel I bars* for the soles. *Steel U bars* for the headstocks, cross bearers and intermediate longitudinals; girder built up of

two *steel U bars* and two *steel plates* for the body bolster; *steel U bars* for the St. Andrew's cross bracings; *steel plate* 10 and 8 mm. (3/8 and 5/16 inch) thick at the ends of the frames to reinforce the connection of the members. All rolled sections are standard. See fig. 23.

- c)2) *Steel L bars* for the pillars and body cross members, *bent copper steel plate* 6 mm. (1/4 inch) thick for the corner pillars; *steel U bars* for connecting together the end pillars; *copper steel bent plate* 4 mm. (5/32 inch) thick for the cant rail; *steel L bar* for the carlines; *steel pressings* 3 mm. (1/8 inch) thick for the roof cross bracings. See fig. 23.
- c)3) *Steel pressings*.
- c)4) *Copper steel pressings* 3 mm. (1/8 inch) thick except at the ends of the body sides where 5 mm. (3/16 inch) thickness is used (against telescoping). The plate is rivetted to the steel framing with visible head rivets.
- c)5) *Steel plate* 1 mm. (3/64 inch) thick screwed to a wood framing bolted to the steel framing. The plate is left bare.
- c)6) *Steel plate* 2 mm. (5/64 inch) thick rivetted to a light framing of *L bars*, fastened to the outer body sides, to the floor, and the roof cross bracings. See fig. 24.
- c)7) *Wood floor* carried by a wood framing; supported on a *steel plate* 1 mm. (3/64 inch) thick. Between the steel plate and the wood floor a layer of *compressed cork* 65 mm. (2 9/16 inches) thick. Over the wood floor *linoleum*.
- c)8) Outside: *copper steel plate* 2 mm. (5/64 inch) thick, butt strapped rivetted joints above the carlines. At the roof ends 4 mm. (5/32 inch) thick plates (anti-telescopic arrangement). Inside: *steel plate* 1 mm. (3/64 inch) thick screwed to wood pattresses bolted to the metal carlines.
- d)1) The heat insulation is obtained by the layer of *compressed cork* between the floor and the under floor.
- d)2) The heat insulation is obtained by a layer of *compressed cork* 60 mm (2 3/8 inches) thick between the inner and outer sheeting, or by a layer of *tared woven felt* 8 mm. (5/16 inch) thick fastened to the

inside lining by wires welded to the plate with the free ends turned round a steel washer.

- d)3) The heat insulation is obtained by a layer of air and a layer of compressed cork 40 mm. (1 9/16 inches) thick.
- e) Riveting. Welding is used for secondary joints only.

Italian State Railways.

(Continued.)

- a) For secondary lines with heavy traffic. — Bogie motor carriages classes EAiz, EACiz, and bogie trailer carriages class eCiz.
- b) The same characteristics as the main line carriages of class Az, Bz, and Cz.
- c)1) The same materials as for the main line carriages.
- c)2) Copper steel plate 4 mm. (5/32 inch) thick up to the waist rail; bent copper steel plate 6 mm. (1/4 inch) thick for the corner pillars; steel L bars for the other pillars; steel U bars and bent copper steel plate 4 mm. (5/32 inch) thick for the cant rail; steel L bars for the carlines; vertical steel plates 3 mm. (1/8 inch) thick for the cross bracing of the roof.
- c)3) Steel pressings and U bars.
- c)4) Up to the waist rail, the same plate as that of the body; from the waist up to the roof 3 mm. (1/8 inch) thick plate. The plate is fastened to the soles, to the headstocks and to the body pillars by countersunk rivets.
- c)5) Steel plate panels screwed to a wood framing bolted to the metal framing. The plate is left bare in the 3rd class and covered with linoleum in the 1st class.
- c)6) Steel plate 2 mm. (5/64 inch) thick applied to a frame work of steel L bars fastened to the frame members, to the body pillars and to the roof cross bracing. The plate is left bare in the 3rd class and is covered with linoleum in the 1st class.
- c)7) Wood floor on a wood framing on an under floor of aluminium plate 1 mm. (3/64 inch) thick. The wood floor is covered with linoleum.

- c)8) Outside: aluminium plate 2 mm. (5/64 inch) thick rivetted butt strap joints over the carlines; at the roof ends steel plate 4 mm. (5/32 inch) thick (against telescoping). Inside: aluminium plate 1 mm. (3/64 inch) thick screwed to wood patresses bolted to the metal carlines.
- d)1) The heat insulation is obtained by a layer of compressed cork 38 mm. (1 1/2 inches) thick inserted between the top and bottom flooring.
- d)2) The heat insulation is obtained by a layer of compressed cork 55 mm. (2 3/16 inches) thick inserted between the inner and outer body linings.
- d)3) The heat insulation is obtained by a layer of air and a layer of compressed cork 38 mm. (1 1/2 inches) thick held up by the inner roofing.
- e) By riveting. Welding is only used for secondary work and for joining up the plates forming the body sides and ends.

Nord Milano Railway (Italy).

- a) For secondary lines with heavy traffic. Composite 1st and 3rd class bogie motor carriages and bogie trailer carriages.
- b) The frame and body form a unit construction, the body frame being of rolled sections. See fig. 25.
- c)1) Steel U bars for the soles, headstocks, cross bearers, and intermediate longitudinals. Wide steel plates for reinforcing the frame connections and the soles in line with the large centre doors. Nearly all the rolled sections are standard. See fig. 25.
- c)2) Steel Z bars for the pillars, steel Z bars and bent plates 3 mm. (1/8 inch) thick for the cant rail; steel Z and L bars for the carlines; vertical steel plate 3 mm. (1/8 inch) thick for the cross bracing of the roof. Nearly all the rolled sections are of standard types. See fig. 25.
- c)3) Steel rolled sections and plates; cast steel for the headstocks.
- c)4) Steel plate 3 mm. (1/8 inch) thick fastened directly to the framing by visible head rivets.

- c)5) Wood framing and aluminium plate panels.
- c)6) Wood framing and aluminium plate panels.
- c)7) Wood floor on wood framing. *Lino-leum* over the wood floor.
- c)8) Outside: wood boards covered with tarred canvas. Inside: aluminium plate; between the linings, compressed cork.
- d)2) The heat insulation is obtained by a layer of air and a layer of cork between the inner and outer roofs.
- d)3) As for the sides.
- f) Riveting.

Società Trazione Elettrica Lombarda (Italy).

- a) For secondary lines. Motor and trailer carriages.
- b) The frame and the body form one unit as if it were a sort of box girder in which the outside body lining plays an essential part in the strength of the body. As regards the platforms, the wood construction has however been retained.
- c)1) Standard rolled steel sections.
- c)2) Steel plate 4 mm. (5/32 inch) thick up to the waist rail and standard rolled steel sections.
- c)3) Cast steel.
- c)4) Up to the waist rail the same plate forming the body framing: above the framing up to the roof steel plate 3 mm. (1/8 inch) thick.
- c)5) Wood panels fastened to a wood framing bolted to the metal structure.
- c)6) Wood panels and framing.
- c)7) Wood floor on wood framing.
- c)8) Outside: wood boarded; inside: aluminium sheet.
- e) Riveting.
- c)2) Steel U and L bars and plate 280×5 mm. (11 1/32 in. × 3/16 in.) for the bottom sides and end bars, steel U bars and flats for the intermediate cross bearers between the longitudinals; steel U and L bars for the pillars; steel plate 150 × 5 mm. (6 in. × 3/16 in.) for connecting together the side pillars (at the waist); steel L bars and plate 200 × 5 mm. (7 7/8 in. × 3/16 in.) for connecting the end pillars; steel angles for the cant rail; steel L bars for end roof carlines and flat bars in pairs for the intermediate carlines. The body is supported by the frame sole bars and by brackets built up of flat bars. See fig. 26.
- c)4) Copper steel plate 2 mm. (5/64 inch) thick screwed to wood pillars secured to the steel pillars with a wood lining under the steel plate.
- c)5) Wood panelling.
- c)6) Wood panelling on a wood frame.
- c)7) Double boarded floor supported by a wood framing. Below the top and bottom floor boards a sheet of asbestos 3 mm. (1/8 inch) thick.
- c)8) Outside: wood boards 20 mm. (3/4 inch) thick covered with sail cloth. Inside: nothing.
- d)1) The heat insulation is obtained by the double floor and by the asbestos sheet in between.
- d)2) The heat insulation is obtained by the layer of air between the inner and outside linings.
- d)3) No provision made.
- e) Riveting.

Polish State Railways.

Prince Henri Railways and Mines (Luxemburg).

- a) For all lines. 6-wheeled centre corridor carriages.
- b) The body and frame are separate. The body is carried by the frame. See fig. 26.
- c)1) Steel U bars for the soles, heastocks, and intermediate longitudinals and cross bearers and the diagonals. See fig. 26.
- a) For the main lines. — Bogie carriages classes Bhuxz, Chrz, Chxz, ABChuxz, and BChuxz.
- b) The frame and body form one unit, the framing being in rolled sections rivetted together. An endeavour has been made to adopt a design to which the builders in the country can work. See fig. 27.
- c)1) Steel U bars for the soles and intermediate longitudinals; built up girders of two steel U bars and two steel plates for the body bolsters and most of the inter-

- mediate cross bearers; *steel U bars* for the other intermediate cross bearers. See fig. 27.
- c)2) *Steel Z bars* of special section for the side and corner pillars; *steel Z bars* and plate 142×8 mm. ($5\frac{1}{2}$ in. \times $\frac{5}{16}$ in.) for the cant rail; *steel Z bars* for the carlines. See fig. 27.
- c)3) *Steel pressings*.
- c)4) *Steel plate* 3 mm. ($\frac{1}{8}$ inch) thick fastened directly to the framing by visible head rivets.
- c)5) *Plywood panels* 12 mm. ($\frac{1}{2}$ inch) thick applied to a *wood framing* fastened to the metal framing.
- c)6) *Wood panels and framing*.
- c)7) *Double framed floor*; top boards 25 mm. (1 inch) thick carried on a wood framing; bottom boards 20 mm. ($\frac{13}{16}$ inch) thick carried on the same wood framing; between the two boards a layer of compressed cork. *Linoleum* over the top floor.
- c)8) Outside: *Steel plate* 2 mm. ($\frac{5}{64}$ inch) thick; inside: *plywood panels* 10 mm. ($\frac{3}{8}$ inch) thick.
- d)1) The heat insulation is obtained by the double floor and the layer of compressed cork between the floor boarding.
- d)2) The heat insulation is obtained by slabs of compressed cork glued on to the outer or the inner panels, and by a layer of air between the linings. The slabs of cork are themselves covered with plywood panels 3 mm. ($\frac{1}{8}$ inch) thick.
- d)3) The same arrangement as with the sides.
- e) *Riveting*. — Electric welding (arc) is only used for secondary work.
- c)4) *Steel plate* 2.5 mm. (0.098 inch) thick fastened directly to the metal framing by visible head rivets.
- c)5) *Wood lining boards*.
- c)6) *Wood lining boards* on a wood framing.
- c)7) *Top floor boards* 30 mm. ($1\frac{3}{16}$ inches) thick on a wood frame; bottom boards 12 mm. ($\frac{1}{2}$ inch) thick on same frame; layer of compressed cork between the top and bottom boards; *linoleum* laid on the top boards.
- c)8) Outside: *steel plate* 2 mm. ($\frac{5}{64}$ inch) thick; inside: *wood lining boards*.
- d)1)2)3) As in the previous carriages.

Swiss Federal Railways.

- a) Main lines. — Bogie carriages, classes AB⁴ü, B⁴ü, C⁴ü, BC⁴ü.
- b) The body and frame form one unit with the framing built up of rolled sections rivetted together. See fig. 28.
- c)1) *Steel U bars* for the soles, headstocks, longitudinals and intermediate cross bars. Built up girder consisting of two *steel V bars* and two *steel plates* for the body bolsters. All rolled sections are standard. See fig. 28.
- c)2) *Steel Z bars* for the pillars; *steel Z* and *L bars* for the cant rail, a *steel Z* and a *steel L bar* for the carlines. All rolled sections are standard. See fig. 28.
- c)3) *Steel rolled sections and plates*.
- c)4) *Steel pressings* 2.5 mm. (0.098 inch) thick fastened directly on the framework by visible head rivets. *Steel plate* 2 mm. ($\frac{5}{64}$ inch) thick above the waist rail.
- c)5) *Plywood panels* fastened to a hard wood framing attached to the steel framework.
- c)6) *Hard wood framing*, panelled in *plywood*.
- c)7) *Top flooring*, of boards 20 mm. ($\frac{13}{16}$ inch) thick on a wood frame; bottom flooring, of boards 14 mm. ($\frac{9}{16}$ inch) thick screwed under the same frame. Between the boards a layer of compressed cork 15 mm. ($\frac{5}{8}$ inch) thick. *Linoleum* above the floor in the 1st and 2nd classes.
- c)8) Outer: *wood boards* 18 mm. ($\frac{11}{16}$ inch) thick covered with sail cloth.
- Polish State Railways.**
(Continued.)
- a) Post office six-wheeled carriages.
- b) The same as that of the previous carriages.
- c)1) *Steel U bars* for the soles, headstocks, longitudinals and intermediate cross bearers.
- c)2) *Steel U and L bars* for the pillars; *steel angles* for the cant rails; *steel L and U bars* for the carlines.

Inner: *wood boards* 12 mm. (1/2 inch) thick or panels of millboard screwed to wood hoopsticks bolted to the metal carlines.

- d)1) The heat insulation is obtained by the *double flooring in wood* and by the *layer of compressed cork*.
- d)2) The heat insulation is obtained by the *layer of air* between the inner and outer body sides.
- d)3) The same as in the case of the sides.
- e) *Riveting*. Electric and autogenous welding is used to some extent in building up the bogies.

Rhaetic Railway.

(Metre gauge.)

- a) For all lines. — Bogie 1st class, 3rd class; 1st and 2nd, and 1st, 2nd and 3rd class composite, carriages.
- b) The frame and body form one unit, the framing being in *rolled sections* riveted together. See fig. 29.
- c)1) *Steel U bars* for the sole bars, longitudinals and some of the cross bearers; built up girder of *steel L bars* and a *steel plate* for the headstocks; built up girder of *two steel U bars* and *two steel plates* for the body bolster and the other intermediate cross bearers. See fig. 29.
- c)2) *Steel Z bars* for the pillars and for the cant rail; *Z or L bars* for the carlines. See fig. 29.
- c)3) *Steel rolled sections* and *plates* riveted together.
- c)4) *Steel plates* 2 mm. (5/64 inch) thick fastened directly to the metal framing by visible headed rivets.
- c)5) *Plywood* panels applied to a *hard wood framework*, fastened to the metal framing.
- c)6) *Hard wood framing* panelled in *plywood*.
- c)7) *Top floor boards* 23 mm. (15/16 inch) thick carried on a *wood framing*; *bottom boards* 14 mm. (9/16 inch) thick fastened under the same framing. Between the boards a *layer of compressed cork* 15 mm. (5/8 inch) thick. In the 1st and 2nd classes, *linoleum* over the floor.
- c)8) Outside: *steel plate* 1.75 mm. (0.069 inch) thick lap jointed and rivetted to the car-

lines. Inside: 3rd class, *wood lining boards* 13 mm. (33/64 inch) thick screwed to *wood* hoopsticks bolted to the metal carlines; 1st and 2nd class, *millboard panels*.

- d)1) The heat insulation is obtained by the double floor and by the *layer of cork* in between.
- d)2) The heat insulation is obtained solely by the *layer of air* between the inner and outer linings.
- d)3) The same arrangement as for the body sides.
- e) *Riveting*, with the exception of the body pillars which are electrically welded to the frame and to the cant rail.

Jugoslav State Railways.

- a) For main lines. — 4-wheeled carriages.
- b) The frame and body form one unit.
- c)1) Standard *steel rolled sections*.
- c)2) Standard *steel rolled sections* and *steel plate* lining.
- c)4) *Steel plate*.
- c)5) *Wood*.
- c)7) *Wood*.
- c)8) *Steel plate*.
- d)2) The heat insulation is obtained by the *layer of air* in between the inner and outer casings.
- e) *Riveting*.

International Sleeping Car Co.

- a) Main lines. — Sleeping cars and restaurant cars (bogie carriages).
- b) The frame and body form one unit, the framing being in *rolled sections*, and *bent plates*.
- c)1) At each end a *steel casting* carrying the whole of the draw and buffing gear. These ends are connected together by sole bars of *U section* and by longitudinals of standard *rolled sections*. *Steel pressings* for the cross bearers.
- c)2) *Steel pressings* for the pillars. *Steel Z bars* for the cant rail. *Steel pressings* for the carlines.
- c)3) *Monobloc steel castings*.
- c)4) *Copper steel plates* 3 mm. (1/8 inch) thick fastened to the framing by countersunk rivets.

- c)5) *Steel plate* 1 mm. (3/64 inch) thick screwed to the framing over strips of *agazote*. The plate is decorated by applying *cellulose lacquers*.
- c)6) *Steel plate* 1.5 mm. (0.059 inch) thick spot welded to a framework built up of pressings. All the partitions are hollow and are covered on their interior faces with cloth to prevent vibrations.
- c)7) *Corrugated steel plate* 1 mm. (3/64 inch) thick covered with light mortar on which are laid *slabs of compressed cork, linoleum, and a carpet*.
- c)8) Outside: *steel plate* 1.5 mm. (0.059 inch) thick butt strapped joints rivetted to the carlines and the heads, electrically welded.
- Inside: *steel plate* 1 mm. (3/64 inch) thick screwed to the metal carlines over strips of *agazote*. In certain carriages *duralumin plate* for covering the roof.
- d)1) The heat insulation is obtained by the *mortar* on the corrugated plating and the *compressed cork slabs*.
- d)2) The heat insulation is obtained by the *layer of air* between the inner and outer linings and by *salamander felt* applied on the interior face of either the inner or outer plate.
- d)3) As with the side walls.
- e) Riveting — countersunk heads. Welding is largely used but not for the parts of the body under stress.

Replies of the Administrations.

Note. — The following administrations do not use light metals or alloys in the construction of metal coaches: **Egyptian State; West of Spain; Est, Midi and Paris-Lyons and Mediterranean (France); Società Trazione Elettrica Lombarda (Italy); Prince Henri Railways and Mines (Luxemburg); Polish State; Swiss Federal; Rhætic; Jugoslav State.**

The **Egyptian State Railways** report however that the use of light alloys such as « *Alpax* » is under consideration.

The **Rhætic Railway** adds what follows :
« No parts are made of light alloys or metals. In the wood carriages built in 1913 and 1914 aluminium was used for the outside lining. The result was not, however, satisfactory; the panels warped after a few years' service, probably owing to the high coefficient of expansion of aluminium and through the great difference of temperature, as much as +18° C. — 30° C. (+64° F. — 24° F), between day and night in the districts in which the carriages were used. In addition corrosion was found at the points where the aluminium sheet was screwed to the body framing. The screws were in galvanised iron or brass. »

OTHER ADMINISTRATIONS :

Belgian National Ry. Co.

- a) For all lines.
- b) None.
- c) Inside roof linings; inside body lining panels; doors; certain interior fittings of 3rd class carriages (luggage racks, light fittings, etc.) *Alpax* (aluminium and silicon alloy — 87 % aluminium, 13 % silicon. $R = 19$ kgr. per mm^2 (12 Engl. t. per sq. inch). $\lambda = 5$ %, $\delta = 2.7$ % or similar alloys.
- e) The question is under investigation.
- f) The saving in weight obtained on only the interior fittings in a 11-compartment carriage with two end vestibules and one lava-

tory is 450 kgr. (990 lb.) relatively, to the weight of the same parts in malleable cast iron or in steel.

- g) The increase in price for the parts indicated under c) above, relatively to malleable cast iron is 11 200 Belgian francs. But relatively to brass there is some saving.

North of Spain.

- a) Motor and trailer carriages on the electrified lines.
- b) None.
- c) Interior linings of the body sides and roof: *Aluminium*.
- d) No special method.
- e) In the first instances no special precautions were taken; but some corrosion has been observed on the aluminium plates.
- f) About 500 kgr. (1 100 lb.).
- g) About 1 % of the value of the carriage.

French State.

- a) Main line carriages.
- b) None.
- c) The covering of the lower part of the partitions: *chequered aluminium*.
The seat supports, the net rack brackets, small interior fittings: *Alpax*.

French State.

(Continued.)

- a) Suburban carriages.
- b) None.
- c) The seat frames; the interior linings: *Duralumin*.
The net rack brackets, the doors: *Alpax*.
- f) Nearly 2 200 kgr. (4 850 lb.) for a carriage of 39 tons tare weight.
- g) 18 000 French francs approximately.

French Nord.

- a) Main line carriages.
- b) None.

- c) The plates covering over the frame openings in the cross partitions (1st and 2nd class); the frames surrounding the seat backs; small interior fittings: *Aluminium*. The side doors (3rd class) the door plates; window frames; luggage net rack brackets; small interior fittings: *Alpax*.
- d) Rivetted and in certain cases screwed. Steel rivets. The use of screws and rivets of « Zincual » alloy (Zn 92-93 % — Cu 3 % — Al 4 %) is under consideration.
- e) All the faces in contact are given two coats of a special paint of boiled linseed oil and wood oil, made adhesive in a special way, white spirit and a pigment composed of yellow ochre, filling up, lithopone, with traces of lead linoleate.
- f) About 400 kgr. (880 lb.) for a 2nd class, 9-compartment carriage (46 tons tare). Nearly 1200 kgr. (2640 lb.) for a 3rd class 11-compartment carriage (43.5 tons tare).
- g) The use of light alloys does not involve any additional cost, if they are used to replace parts in bronze or parts in steel, difficult to make (doors, etc.). On the contrary, if they are used with the object of lightening a carriage, the cost price is considerably increased.

French Nord.

(Continued.)

- a) Suburban carriages.
- b) None.
- c) The inside lining of the body sides and the roof; joint mouldings; 3rd class seat frames; hat hooks; perforated plates for the luggage rack brackets (3rd class); electric cable couplings, etc. — *Aluminium*. The double sliding doors of the vestibules and luggage compartment; the frame work of the sections; the luggage rack brackets; electric lighting details, etc.: *Alpax*.
- d) Nuts, studs, screws, bolts, rivets: *Duralumin*.

Paris-Orleans.

- a) Main line carriages.
- b) None.
- c) Certain decorative details in the 2nd class compartments, the lavatories, and the 2nd

class corridors: « *Aereal* » (alloy of manganese, copper, cadmium, ferro-silicon, aluminium, = 2.7 to 2.8).

Paris-Orleans.

(Continued.)

- a) Suburban carriages.
- b) None.
- c) Outside roof plates: *Duralumin*. — Inside panelling plates: *Alferium* or *duralumin*. — Inside ceiling linings: Either *aluminium* or *duralumin*.
- d) Rivets of the same metal as the details to be secured.
- e) A thick layer of an *asphaltic varnish* is applied between the ferrous and the light metals or alloys.
- f) Nearly 1100 kg. (2240 lb.) when using for the outside roof aluminium plates 2 mm. (0.079 inch) thick in place of steel plates of the same thickness, and by using also an interior lining in alferium plate 1.5 mm. (0.059 inch) thick instead of copper steel 1 mm. (0.0395 inch) thick.
- g) An additional cost of about 3.5 % for each carriage (carriages ordered in 1929).

Italian State.

- a) 1st class, 2nd class and 3rd class main line carriages.
- b) None.
- c) The outside roof plates; the inside roof plates; the inside lining of the body sides, ends and doors; the whole of the lower part of the cross partitions up to the top of the seat backs; the top part of the corridor partitions; panelling plates on the cross and corridor partitions; the pillars connecting the cross partitions with the corridor partitions; the seat supports; the floor under the seats; the *corrugated* plates of the underfloor and its supports placed along the frame longitudinally: *Cold rolled aluminium*. The radiators and the steam heating metallic couplings; the window frames; the lavatory floor and the grating above it; the frame of the entrance doors: *Aluminium-silicon alloy* (Al 87 %, Si 13 %, R = 17 to 20 kgr./mm² (12.7 Engl. tons per sq. inch), λ = 2.5 %).

d) By riveting by means of bent over steel joints, so that the sheets are taken between two steel parts. — Steel rivets.

e) A coat of red lead paint is applied to the surfaces in contact or a piece of cloth soaked in red lead paint is inserted between these surfaces.

f) About 8 800 lb. on carriages the tare weight of which would have been 46 tons if built without light metals.

g) An increase in cost of 7.1 % for 1st class carriages; of 7.8 % for 2nd class carriages; of 11.3 % for third class carriages.

Nord Milano.

a) Electric motor and trailer coaches.

b) None.

c) Body sides and roof inside linings: *Aluminium*.

International Sleeping Car Company.

a) Certain coaches in which an endeavour was made to obtain lightness.

b) None.

c) Roof covering: *Duralumin*.

Replies of the Administrations ⁽¹⁾.

Belgian National Ry. Co.

- a) 1) For open wagons (high sided) only, The wood floor is however retained.
In the case of the covered wagons the composite construction i. e. frame and body framing in steel; body panelling in wood, is preferred. The Company possesses however a small number of all-metal covered wagons.
- a) 2) Reduction in tare weight; greater rigidity; more easily repaired; easier maintenance; use of materials of national manufacture. Better heat insulation.
- b) Diagrams Nos. 1 and 2 show some of the classes of all-metal wagons mentioned in a).
- c) 1) Covered: 0.5 % of the stock of covered wagons.
- c) 3) High sided: 34.4 % of the stock of high sided wagons.
- d) 1) Covered: 96 % of the stock of covered wagons.
- d) 3) High sided: 63.5 % of the stock of high sided wagons.
- c) Relatively to the total stock of wagons: 21.9 %.
- d) Relatively to the total stock of wagons: 75.4 %.
- e) Rolled sections of ordinary steel both for the frame and for the body framing.
Ordinary steel plates for the lining.
- f) Red lead or linseed oil paint.
- h) Riveting. — For trial purposes several wagons have been welded throughout. See also Appendix VI.

Lower Congo to Katanga.

(3 ft. 6 in. gauge) Belgian Congo.

- a) For all wagons (covered, flat, high sided, hoppers), excepting only those for carrying

Note. — The railways not mentioned in the present summary have either not supplied any information or have replied that they do not possess any all-metal wagons.

cattle. In the case of the open wagons the floor is of steel. — Greater strength; less risk of fire; less maintenance.

- b) An endeavour has been made in building these wagons to get the lightest possible weight. They are also designed so that they can easily be taken apart for export. Diagrams Nos. 3 and 4 show some of the classes of all-metal wagons mentioned under a).
- c) Practically the whole of the stock of wagons.
- e) Ordinary steel and copper bearing steel. The latter has been used in the case of wagons used for carrying mineral and coal traffic in order to reduce corrosion.
- f) Different kinds of paints have been tried but without success.
- g) In the metal covered wagons, the sides, roof and floor are lined out inside with wood. Between these linings and the outside plating an air space is left.
- h) Riveting.

Egyptian State.

- a) 1) For all covered and open wagons. Even in the case of the covered wagons the floor is of steel.
- a) 2) Greater strength; cheaper to maintain.
- b) Diagrams Nos. 5 and 6 show some of the classes of all-metal wagons mentioned under a).
- c) 1) 99 % of the stock of covered wagons.
- c) 2) 37.5 % of the stock of flat wagons.
- c) 3) 60 % of the stock of high sided wagons.
- e) Ordinary rolled steel sections for the frames and body framing. Mild steel for the sides. Galvanised steel for the roof. As an experiment copper bearing steel (0.3 % copper) has been used on several vehicles.
- f) Red lead.
- g) As a rule covered wagons are not fitted with any insulating material.
- h) Riveting.

North of Spain.

- a)1) Flat wagons only. Even in the case of the all-steel wagons a wood floor is preferred. For all the other designs of wagons the composite construction — metal frame and body framing, and wood body lining — is preferred.
- a)2) Greater strength in the case of the flats. Better heat insulation in the case of the others.
- b) Some of the all-metal flat wagons mentioned under a) are shown in diagram No. 7.
- c)2) 25 % of the stock of flat wagons.
- d) Almost the whole stock of the wagons.
- e) Ordinary steel rolled sections, plates, castings and forgings.
- f) Red lead and ordinary paint.
- h) Riveting.

French State.

- a)1) For open wagons only (high sided, low sided, or flats). A wood floor is preferred even on the all-metal wagons. In the case of covered, insulated wagons and express parcels' wagons the composite construction, i.e. frame and body framing in metal, body lining in wood, is preferred.
- a)2) Open wagons: greater strength; cheaper maintenance. Covered wagons: better heat insulation.
- b) The all-metal wagons are of the standard French Railway type designed by the O.C.E.M. Some of these wagons are shown in diagrams Nos. 8, 9, and 10. In the case of the frame an endeavour has been made to prevent the ends getting out of shape through violent shocks by strongly crossplating them together so as to box them in. As regards the body an endeavour was made to design the framing in such a way that it would not get out of shape under violent shocks, either accidentally or in service when loading, unloading or shunting.
- c) Relatively to the total stock of wagons :
c)1) 0.5 %; c)2) 1 %; c)3) 5.5 %.
A total of 7 %.
- d) Relatively to the total stock of wagons :

d)1) 38.5 %; d)2) 17 %; d)3) 24.5 %.

A total of 80 %.

- e) Ordinary steel rolled sections and plain and pressed plates.
- f) Red lead paint.
- h) Riveting (see also Appendix VI).

Alsace-Lorraine (France).

- a)1) For open wagons (flat and high sided) only. A wood floor is preferred even in the case of all metal wagons. As regards the covered wagons the end walls have been reinforced by a 2 mm. (5/64 inch) thick steel plate up to a height of 1 m. (3 ft. 3 3/8 in.) above the floor as an experiment.
- a)2) Open wagons: cheaper maintenance. As regards the wood floor the steel plate floor corrodes very quickly; it is slippery and consequently dangerous.
- b) The all-metal wagons are of the standard French Railway type. Some of these wagons are shown on diagrams Nos. 8, 9 and 10.
- c) Relatively to the total stock of wagons :
c)1) Nil; c)2) 4.4 %; c)3) 18.3 %.
A total of 22.7 %.
- d) Relatively to the total stock of wagons :
a total of 77.3 %.
- e) Rolled steel, L, U, and Z bars. Plain and pressed plates. Most of the rolled sections and plates used in the frame and body framing are of copper steel (copper 0.25 to 0.40 %). On 300 high sided wagons, « Armco » iron has been used for the soles, headstocks, angles carrying ends of floor boards, and 250 by 8 mm. (5/16 in. × 9 7/8 in.) flats placed over the headstocks. All the other parts of the frame and body framing as well as the lining plates are of copper bearing steel.
- f) Special anti-rust paints are under test, composition generally not known.
- h) Riveting.

French Est.

- a)1) For open wagons (flat wagons with low sides and without sides, and high sided wagons) only.

The wood floor is preferred even in the case of the all-metal wagons.

In the case of covered wagons the composite construction, i.e. frame and body framing in metal, body lining in wood, is preferred.

a) 2) In the case of the open wagons: cheaper maintenance through the correspondingly reduced damages as compared with those arising out of the weakness of rolling stock built of wood or of wood and metal.

b) The all-metal wagons are of the standard French Railway type designed by the O.C. E.M. In addition the Company possesses coal and mineral wagons to its own designs. Some of these wagons are shown in diagrams Nos. 8, 9, 10 and 11.

c) 1) Nil.

c) 2) 74 % of the stock of flat wagons.

c) 3) 12.5 % of the stock of high sided wagons.

d) 1) 80 % of the stock of covered wagons.

d) 2) 26 % of the stock of flat wagons.

d) 3) 87.5 % of the stock of high sided wagons.

c) Relatively to the total stock of wagons: a total of 17.5 %.

d) Relatively to the total stock of wagons: a total of 74.5 %.

e) Ordinary steel rolled sections and plates. For trial purposes a copper bearing steel (0.4 % copper maximum) has been used on some wagons. The results are not yet available.

f) Graphite paint.

For trial purposes 2 wagon frames have been metal coated by the « Schoop » process which consists in spraying volatilised zinc by compressed air. The results have been satisfactory.

h) Riveting. In some cases butt and electric arc welding is used to connect some parts of the body framing to the frame.

See also Appendix VI.

French Midi.

a) 1) Only for flat wagons and some classes of high sided wagons not used in coal traffic.

The wood floor is preferred even in the case of all-metal wagons.

a) 2) Greater strength and safety.

b) Diagram No. 12 shows one of the classes of all-metal flat wagons mentioned in a).

c) 13.5 % of the total stock of wagons.

d) 64 % of the total stock of wagons.

e) Standard rolled sections, plain and pressed plated in ordinary steel.

f) Red lead paint.

h) Riveting.

French Nord.

a) 1) Only for open wagons (flats and high sided). Even in the case of all-metal wagons a wood floor is preferred.

As regards covered wagons 4 000 were built during the war entirely in metal but the composite construction of a metal frame and body framing with wood lining is now preferred.

a) 2) Open wagons: greater strength.

Covered wagons: better heat insulation.

b) Diagrams 13, 14, 15 and 16 show some of the all-metal wagons mentioned in a).

In the case of 20-ton high sided wagons (diagram No. 13) and the 60-ton self-discharging wagons (diagram No. 14) bent and pressed plates alone have been used even for the frame, without there being any girder work either in the body or the frame. These plates form as it were rectangular box girders welded together as well as to the headstocks and to the side longitudinals which themselves are formed of bent plates and are able to stand up without deformation to violent shocks.

c) 1) 15.5 % of the stock of covered wagons.

c) 2) 6 % of the stock of flat wagons.

c) 3) 30 % of the stock of high sided wagons.

Relatively to the total stock of wagons:

1) 4.7 %.

2) 1 %.

3) 15.8 %.

A total of 21.5 %.

d) 1) 61 % of the stock of covered wagons.

d) 2) 49 % of the stock of flat wagons.

d) 3) 39.5 % of the stock of high sided wagons.

Relatively to the total stock of wagons:

1) 18 %.

2) 8 %.

3) 21 %.

A total of 47 %.

e) Rolled steel sections, steel plates, cast steel, steel pressings. Most of the rolled sections and plates used in the frame and body framing are in copper bearing steel.

f) Iron oxide paint.

g) No special arrangement.

h) Generally riveting; but in recent high sided 20-ton wagons (diagram No. 13), all the body and frame joints have been made by welding alone.

The steel castings and those parts which have to be easily replaced have however been rivetted or bolted.

The welded construction has also been used for the 60-ton high sided self-discharging wagons (diagram No. 14).

See also Appendix VI.

Paris-Lyons-Mediterranean Railway.

a)1) Only for open wagons (flat and high sided).

The construction of all-metal covered wagons has not yet been definitely decided upon. At the present time nearly all the covered wagons have wood sides, the frame and body framing being in steel.

a)2) Open wagons : greater strength.

Covered wagons : better heat insulation.

b) The all-metal wagons are of the standard French Railway type designed by the O.C.E.M.

Some of these wagons are shown on diagrams Nos. 8, 9 and 10.

c)1) Nil.

2) 30 % of the stock of flat wagons.

3) 44 % of the stock of high sided wagons. Relatively to the total stock of wagons :

1) Nil.

2) 3.6 %.

3) 19.3 %.

A total of 22.9 %.

d)1) 100 % of the stock of covered wagons.

2) 70 % of the stock of flat wagons.

3) 56 % of the stock of high sided wagons. Relatively to the total stock of wagons :

1) 44.7 %.

2) 8.7 %.

3) 23.7 %.

A total of 77.1 %.

e) Rolled sections and steel plates, cast steel, steel forgings.

Most of the rolled sections and plates used in the frame and body framing are of copper bearing steel.

f) Aluminium paint.

h) Riveting.

Paris-Orleans Railway.

a)1) For flat and high sided wagons only.

100 bogie all-metal high sided coal wagons have metal floors also; as a general rule the wood floor is preferred.

In the case of covered wagons the composite construction, i.e. frame and body framing in metal with wood body linings, is preferred.

a)2) Flat and high sided wagons : if the floor is in steel plate it oxidises quickly under the action of certain materials; it is not so convenient for shovelling owing to the rivets projecting; it oxidises rapidly owing to water resting in hollow places resulting from the plates getting out of shape.

Covered wagons : better heat insulation; more easily maintained; the side walls corrode rapidly if they are in steel, especially if the wagon is used to carry cattle.

b) The all-metal wagons are of the French Railway standard type to the O.C.E.M. designs, with the exception of the high sided wagons mentioned under a) and shown in diagram No. 17.

c) Relatively to the total stock of wagons :

1) Nil.

2) 9 %.

3) 3.4 %.

A total of 12.4 %.

d) Relatively to the total stock of wagons :

1) 27.5 %.

2) 2.4 %.

3) 17.8 %.

A total of 47.3 %.

e) Rolled sections, plain and pressed plates in ordinary steel; copper bearing steel (0.2 to 0.5 % copper) has been used in the construction of the latest high sided wagons.

f) Red lead paint.

h) Riveting.

Thiès to the Niger.

(French Colonies.) — (Metre gauge.)

- a) 1) 20 all-metal covered wagons are being tested.
No decision can be come to regarding the extended use of this type of wagon until the wagons mentioned have been tried out. The floor is also of steel.
- a) 2) Greater strength and less risk of fire.
- b) Diagram No. 18 shows the all-metal wagons mentioned under a).
- c) 1) 3.5 % of the stock of covered wagons. Relatively to the total stock of wagons: 1.6 %.
- e) Ordinary mild steel.
- f) Red lead paint.
- g) No special arrangement adopted.
- h) Riveting. Riveting is preferred to welding in view of the equipment available on the railway.

Moroccan Railways.

- a) 1) For open wagons (flat and high sided) and hopper wagons for carrying phosphates only.
The covered wagons have a wood body or a steel body framing with wood panels.
- a) 2) Greater resistance to shock; less difficult to maintain; easier to repair. In addition the deterioration of the wood through the heat is avoided.
- b) The all-metal wagons are of the standard French Railway type.
- c) Relatively to the total stock of wagons: a total of 50.8 %.
- d) Relatively to the total stock of wagons: a total of 9.5 %.
- e) Rolled sections and plates in ordinary steel, copper steel plates are under test.
- f) The trials made with anti-corrosion protective paints have not given good results. Iron oxide paint continues to be used.
- h) Riveting.

Italian State.

- a) 1) For all new wagons whether open (flat and high sided) or covered.
Even in all-metal wagons the wood floor is preferred.

a) 2) Open wagons: greater strength to shock; cheaper to maintain; longer life.

As regards the floors: the steel floor oxidises rapidly under certain loadings; it does not lend itself, unlike the wood floor, to fitting wedges to secure the loads; it is slippery.

In the case of wagons in service the all-metal construction has been adopted for open wagons only.

- b) An endeavour has been made to obtain great resistance to violent shocks by strongly boxing in both ends of the frame. In the case of the body particular care has been given to the joints connecting the different parts of the body framing, to ensure that it will not get out of shape. Diagrams Nos. 19 and 20 show the metal open wagons (flat and high sided) mentioned under a).

- c) 1) Nil.
- 2) 25 % of the stock of flat wagons.
- 3) 9.4 % of the stock of high sided wagons.
- c) Relatively to the total stock of wagons: 1) Nil.
- 2) 2 %.
- 3) 4 %.
- A total of 6 %.
- d) 1) 59 % of the stock of covered wagons.
- 2) Nil.
- 3) 90.6 % of the stock of high sided wagons.
- d) Relatively to the total stock of wagons: 1) 28 %.
- 2) Nil.
- 3) 38 %.
- A total of 66 %.
- e) Standard rolled sections and plates in copper bearing steel.
- f) Iron oxide and linseed oil paint.
- g) In the all-metal covered wagons built in future the roof and the sides will be fitted with wood inside linings.
- h) Riveting.
The use of welding is under consideration.

Prince Henri (Luxemburg).

- a) 1) For open (flats and high sided) wagons only. Even in the case of all-metal wagons the wood floor is preferred. In the case of covered wagons the composite construction

is preferred, i.e. frame and body framing in steel with wood body panels.

a)2) Open wagons: greater strength and greater rigidity; a better ratio between the useful load and the tare.

Covered wagons: the lack of ventilation would favour the rapid wear of the body if this latter were all-metal.

b) Diagram No. 21 shows one of the all-metal high sided wagons.

c) Relatively to the total stock of wagons, a total of 56 %.

d) Relatively to the total stock of wagons: a total of 44 %.

e) Rolled sections in ordinary mild steel. Plates in copper bearing steel (copper content 0.25 to 0.50 %).

f) « Ferriline » paint.

h) Riveting.

Lourenço-Marquês.

a)1) For all new wagons. The first wagons put into service when the line was opened have wood bodies.

a)2) Greater resistance to shock; cheaper to build and maintain.

c) Relatively to the total stock of wagons: 1) 5 %.

2) 41 %.

A total of 46 %.

d) Relatively to the total stock of wagons: a total of 52 %.

e) Steel rolled sections and plates. The steel plates of the body contain 0.25 % of copper.

f) Anti-corrosive paint of the Hartman type.

g) No special arrangement.

h) Riveting.

Rhætic Ry.

(Metre gauge.)

a)1) For the drop side wagons used for carrying sand and gravel only. The floor also is in metal.

For all other wagons the composite construction with the body framing in iron and wood linings is preferred.

a)2) The increase of weight resulting from the metal construction is not desirable especially on lines with heavy gradients.

c) Relatively to the total stock of wagons:

1) 0; 2) 3.9 %.

d)1) Relatively to the total stock of wagons: 1.5 %.

e) Rolled sections and plates of ordinary steel.

f) Red lead.

h) Riveting.

Jugoslav State.

a) Some of the coal and mineral wagons only are all-metal.

The question of using the all-metal construction has not yet been decided. Most of the new wagons are in wood.

c)3) 2 %.

e) Ordinary steel in standard sections.

f) Red lead.

h) Riveting.

Replies of the Administrations.

Belgian National Ry. Co.

Carriages.

- a) As an experiment the whole of the joints of a metal carriage of the international type.
- b) Electric arc and spot welding.
- c) In the case of continuous and important welds the parts to be welded together are assembled provisionally by securing them in stout rigid gauges or forms. A number of welds of short lengths at different points are then made before the final welding is started. After welding is completed the deformations and any warping which in spite of the above mentioned precautions take place are removed by means of the method known as « contraction heating » which consists in heating with the flame and by small surfaces at a time the deformed places and then allowing them to cool.
- c) It is not possible to give any exact information.
- d) The information available is not such as to make it possible to express an opinion.

Wagons.

- a) As a test 51 wagons built in 1928-1929 were welded throughout.
- b) Arc welding.
- d) A saving of 800 kgr. (1 760 lb.) on wagons with riveted joints weighing 11 130 kgr. (24 530 lb.) equal to a saving of 7.1 %.
- e) It may now be said that in the case of wagons it will be advantageous to weld them instead of riveting, with the reserve, however, that certain parts that have to be renewed continue to be riveted. Actually welding makes it possible to obtain stronger joints than the riveted joints and in consequence it is possible to reduce the dimensions of the rolled sections. It is also probable that repairs will be less serious as the slackening of the joints should disappear when welding is adopted.

Lower Congo to Katanga.

(3 ft. 6 in. gauge.)

Wagons.

- a) Welding is not employed.
- e) It is thought that, in the case of the frames, welding can be partly substituted with advantage for riveting.

Egyptian State.

Wagons.

- a) Welding is not used.
- e) It is considered that welding can be substituted with advantage for riveting for parts which are not frequently replaced.

North of Spain.

Carriages.

- a) Welding is not used.
- e) No experience, but it is thought that welding can be used in place of riveting without danger for joining together certain parts of the frame and of the body framing.
- a) Wagons. — Welding is not used.

West of Spain.

- a) Carriages. — Welding is not used.

French State.

Carriages.

- a) No important joints are welded. Up to the present welding has been used only for fastening secondary parts.
- b) Autogenous and electric welding. When fixing stiffening plates to the linings spot welding has been used (resistance welding).
- e) It is thought that welding can be increasingly used without any disadvantages for various joints of body parts in place of riveting.

Wagons.

- a) No joints welded.
- e) The results of experiments being carried out by other railways are being followed.

Alsace-Lorraine.

- a) *Carriages and wagons.* No important joint is welded.

French Est.

Carriages.

- a) Body framing joints. Welding is also used for connecting together secondary parts as well as for fixing the bent steel stiffening plates on the plates forming the partitions.
- b) Both continuous arc welding and welding with electric arc on countersunk holes. For fastening the stiffeners on to the plates forming the partitions electric spot welding is used. (Resistance welding.)
- c) Continuous and important welds are carried out by partial welds separated by fairly considerable intervals over which the welding is done in the second stage.
- c) Welding on countersunk holes is carried out after the plates have been first held together by a few staggered rivets. After welding the deformed parts are heated with the flame and then rapidly cooled off by compressed air while the plate is levelled off by hammering.
- d) No comparative data, welding having been widely used when the metal construction was first introduced.
- e) The tendency is towards the general use of welding for the body framing and frame joints. As by welding it is possible to get better joints, the breakdown of the paint and the corrosion will be lessened as these defects generally occur at the joints and the rivet heads. The welded joints will also be much more uniform.

Wagons.

- a) Only certain joints between the body and the frame.
- b) Butt welding as well as electric arc welding.

- d) Not sufficient comparative data. It is however considered that an appreciable saving of weight will be obtained, all joint details such as gusset plates and angles no longer being needed.
- e) Before the use of welding can be made general it is desirable at the present time to consider if the different workshops can get together suitable equipment for this method of manufacturing. Apart from this reserve, the general use of welding will lead to more rational and cheaper methods of construction, on condition that the design of the parts of the vehicles and the joints be such as to suit this new method.

French Midi.

- a) *Carriages and wagons.* No important joint is welded.

French Nord.

Carriages.

- a) Joints of the steel body parts and framing, and of the frame.
- b) Autogenous welding, arc welding, electric spot welding, butt welding, according to the case.
- c) The parts to be put together have to be held together in very solid forms. In the case of certain compartment doors made up of two metal plates separated by stiffeners and welded together, the welds are carried out in water.
- d) Impossible to give a figure of the saving in weight because the use of welding corresponded with the introduction of pressed steel parts.
- e) Welding should be made general for the body and frame detail joints; the joints are more complete, and are better able to withstand mishandling in service and consequently ensure the carriages standing up better.

Wagons.

- a) High sided wagons and 8-wheeled non bogie, self-discharging wagons. All the joints of the body framing and the frame

except in places where the welding equipment cannot be used and except for fastening the steel castings and details which have to be replaced frequently.

- b) Autogenous welding, both by the flame and by the electric arc, and electric spot welding according to the case.
- d) In the case of the high sided wagons, 400 kgr. (880 lb.) per wagon (tare = 8 500 kgr. = 18 700 lb.); it is estimated that the saving of weight could be as much as 800 kgr. (1 760 lb.).

Paris-Lyons & Mediterranean.

Carriages.

- a) Latest metal carriages of the O.C.E.M. design.
Joints of the different plates forming the outside body lining.
- b) Autogenous welding by arc or flame, for joining together the plates.
Electric spot welding for fastening the reinforcement bars at the plate welds.
- c) After the plates have been autogenously welded they have to be levelled by rolling. On the other hand electric spot welding when done quickly and at high current intensity prevents the plates from getting out of shape (intensity of current: 600 amp.; tension: 220 to 250 volts, time for each spot weld: 1 second).
- d) Welding has been adopted to do away with all visible rivets on the outside surfaces, and not to reduce the weight.
- e) Impossible to give a well founded opinion the carriages with welded joints not yet being in service.

Wagons.

- a) Welding is not used.
- e) Impossible to give a reasoned opinion owing to lack of experience of the use in service of welded wagons.
Arrangements have, however, been made in common with other railways to design all-metal high sided wagons.

Paris-Orleans.

Carriages.

- a) No important joints are welded.
- e) It would appear to be beneficial to weld the joints if future metal carriages were designed accordingly. The question is under consideration.

Wagons.

- a) Welding has not been used.

Morocco Rys.

- a) Wagons. Welding is not used.

Thiès to the Niger.

(Metre gauge.)

Wagons.

- a) Welding is not used.
- e) Riveting is thought to be preferable to welding in view of the railway's available facilities.

Italian State.

Carriages.

- a) Welding is used for connecting together different parts of the plates and of the outside body lining, and for other secondary joints. It is also used to ensure watertightness.
- b) Continuous welding by flame or electric arc.
- c) After welding the plates are levelled by rolling.
- d) In the case of a covered carriage welded throughout, built as an experiment, the reduction in weight of the frame was 11 %. In the case of the body no exact comparison can be given.
- e) It may now be considered that welding will be largely used in the construction of railway vehicles in place of riveting. But in this change the greatest care must be taken as it is only after long experience in service that we can be sure that each welded joint shows real advantage over riveting.

Wagons.

- a) Welding is used for secondary work only.

Nord-Milano.

Carriages.

- a) No important joints are welded.
e) It is considered that welding may make it possible to lighten the construction considerably, but on the other hand it is thought that riveting is usually more suitable, especially as it makes it easier to repair any parts of the body after serious damage.

Prince Henri (Luxemburg).

- a) *Carriages and wagons.* No important joint is welded.

Polish State.

Carriages.

- a) Welding is only used for secondary work (watertightness, etc.)
b) Electric arc.

Lourenço-Marquês.

Wagons.

- a) No important joint is welded.
e) Not sufficient experience to express an opinion.

Swiss Federal.

Carriages.

- a) Welding is used to some extent for bogie frame joints.
b) Electric and autogenous welding.
e) At the present time, riveting is preferred.

Rhætic Ry.

(Metre gauge.)

Carriages.

- a) Welding is used for securing the body pillars to the frame and to the cant rail.
b) Electric welding.

Carriages and wagons.

- e) As few joints have been made by welding, it is not yet possible to form a definite judgment as to the general use of welding. It is however considered that with staff thoroughly expert in electric welding it would be beneficial for all vehicles to be welded instead of rivetted.

Wagons.

- a) Welding is only used for tank wagons; in these the reservoir is welded throughout.

Jugoslav State.

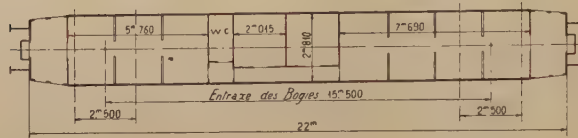
- a) *Carriages and wagons.* No important joint is welded.

**Diagrams of a few of the all-metal carriages in service, being built
or designed at the 1st January 1932,
exclusive of those dealt with at the Madrid (1930) Congress.**

Belgian National Railway Company.

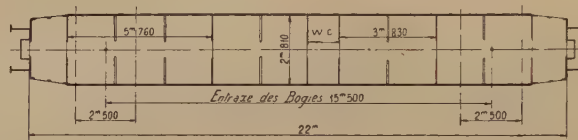
Number of places :

1. Composite : 1st and
2nd classes.



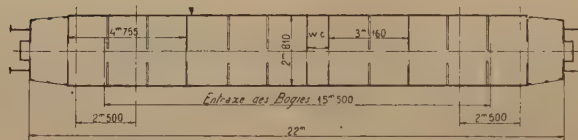
1st cl. : 12.
2nd cl. : 60.

2. 2nd class.



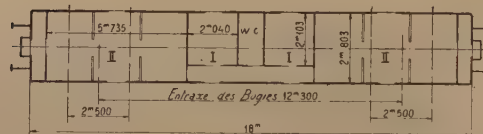
76

3. 3rd class.



112

4. Composite : 1st and
2nd classes.



1st cl. : 12.
2nd cl. : 48.

5. 3rd class.

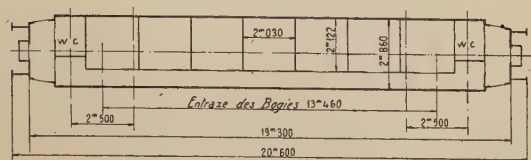


94

West of Spain Railway.

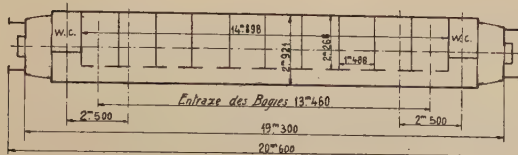
Number of places:

6. 1st class A^WFHV.



42

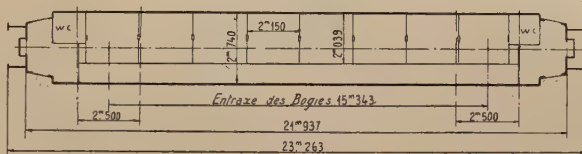
7. 3rd class C^WFHV.



80

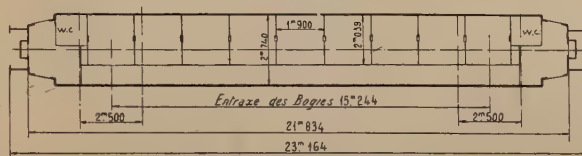
French State Railways.

8. 1st class. A⁸yfi and A⁸C³yfi (O. C. E. M. type).



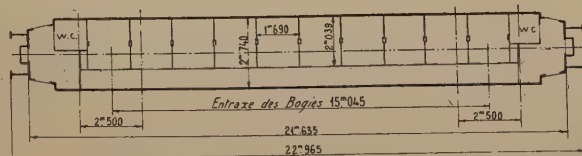
48

9. 2nd class. B⁸yfi (O.C. E.M. type).



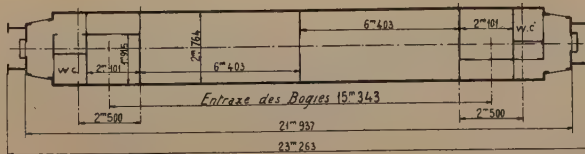
72

10. 3rd class. C¹⁰yfi (O.C. E.M. type).



80

11. 1st class. A⁴yfi (O.C. E.M. and State type).

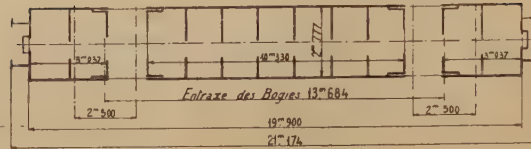


32

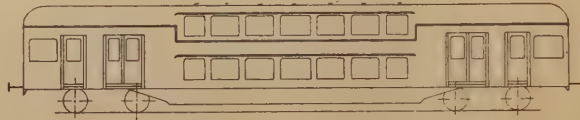
French State Railways. (Continued.)

Number of places:

12. 3rd class (suburban),
C³yfp, and 2nd class,
B³yfp (O.C.E.M. type).

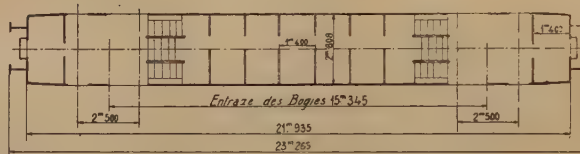


98



Vestibules and upper deck.

13. Double deck, 3rd class
(suburban). Cyfi (de-
sign), State type.



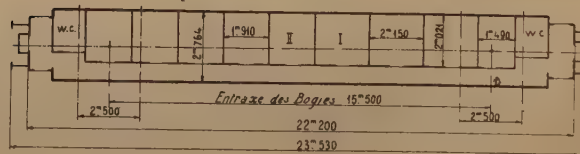
142

Lower deck.



French Est Railway.

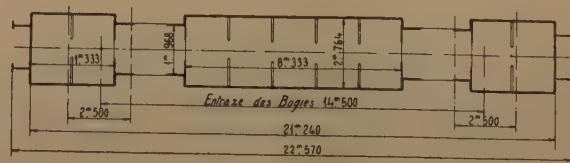
14. Composite: 1st and
2nd classes, A^{3 1/2}B⁵
yfi.



1st cl.: 21.

2nd cl.: 40.

15. 2nd class, Bxxy (sub-
urban).

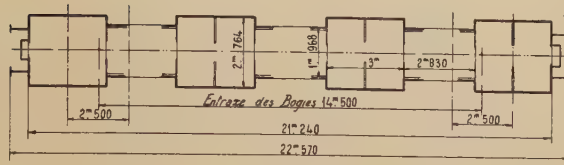


100

French Est Railway. (Continued.)

Number of places :

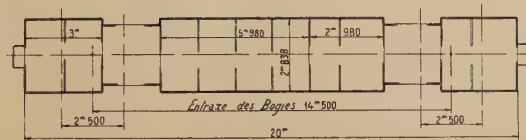
16. 3rd class, Cxxg (sub-urban).



90

French Nord Railway.

17. Composite : 1st and 2nd classes, AByi (sub-urban).

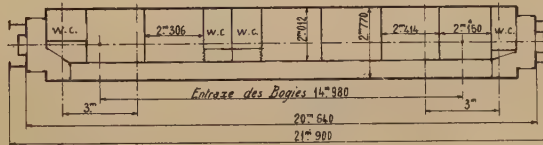


1st cl. : 24.

2nd cl. : 58.

Paris-Lyons-Mediterranean Railway.

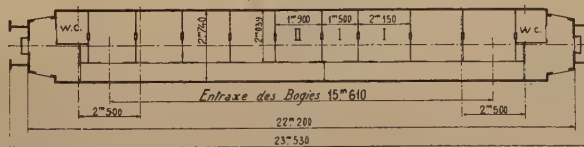
18. 1st class, with sleeping accommodation, A³c²L³g³yfi.



24

Paris-Orleans Railway.

19. Composite : 1st and 2nd classes, A³ 1/2 B²yfi (O.C.E.M. type).

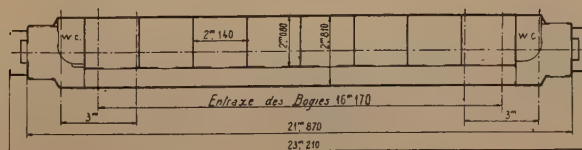


1st cl. : 21.

2nd cl. : 40.

Italian State Railways.

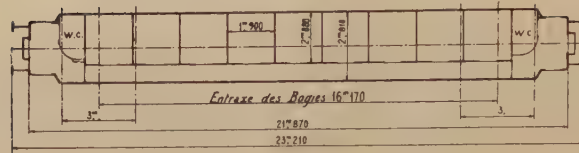
20. 1st class, Az.



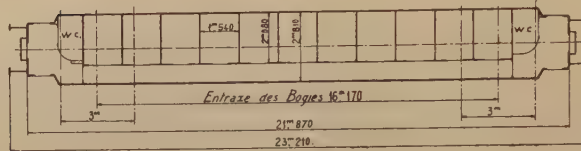
48

Number of places:

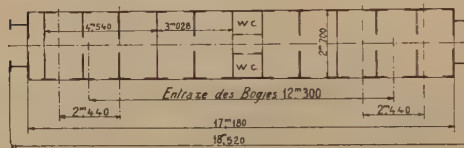
- 72



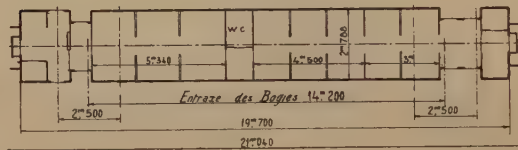
- 88



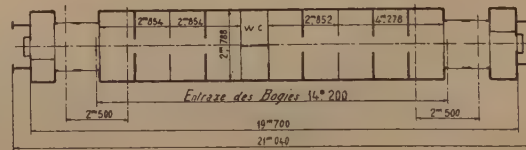
- 80



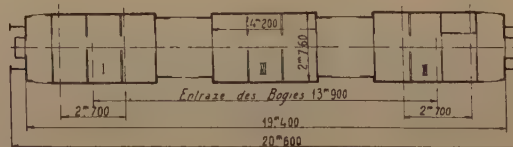
- 1st cl. : 23.
2nd cl. : 39.



- 71



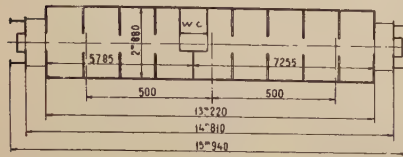
1st cl. : 30.
2nd cl. : 65.



Prince Henri Railways (Luxemburg).

Number of places:

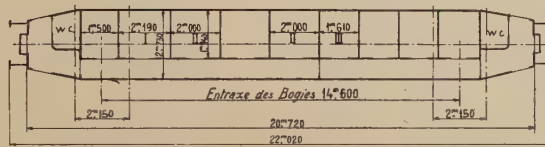
27. 3rd cl., 6-wheeled.



68

Polish State Railways.

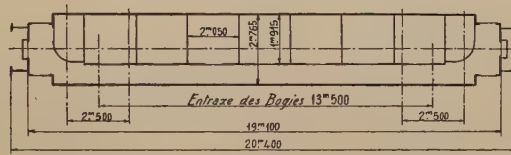
28. 1st, 2nd and 3rd cl.,
ABChuxz.



1st cl. : 6.
2nd cl. : 18.
3rd cl. : 32.

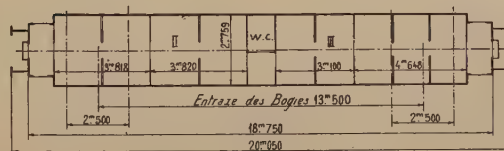
Swiss Federal Railways.

29. 2nd class, B⁴u.



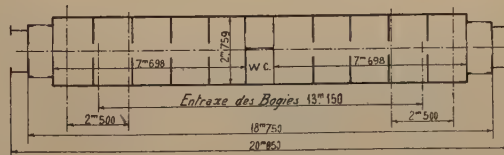
42

30. 2nd and 3rd classes,
BC⁴u.



2nd cl. : 31.
3rd cl. : 39.

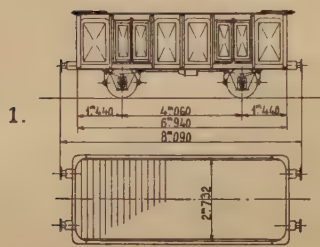
31. 3rd class, C⁴u.



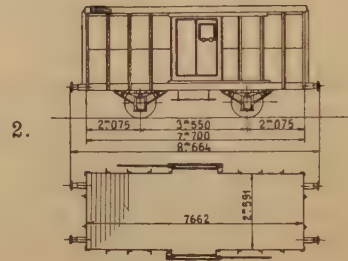
78

Diagrams of some of the all-metal wagons mentioned
in Appendix IV.

Belgian National Railway Company.

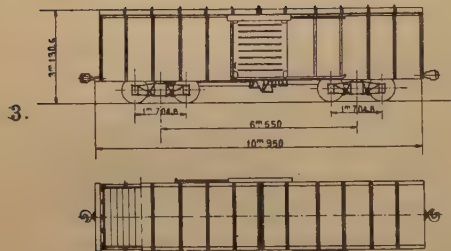


20-ton high-sided wagon.

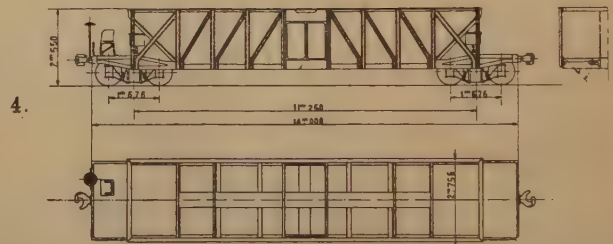


20-ton covered wagon.

Lower Congo to Katanga Railway.

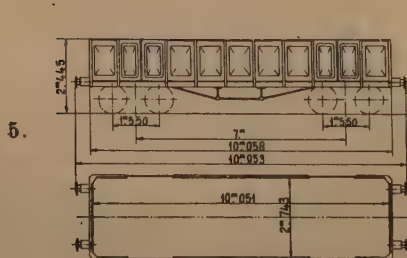


20-ton covered wagon.

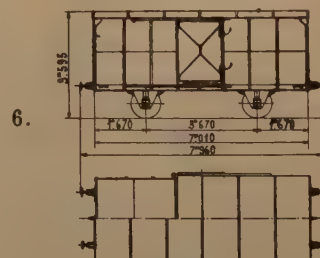


40-ton high-sided wagon.

Egyptian State Railways.

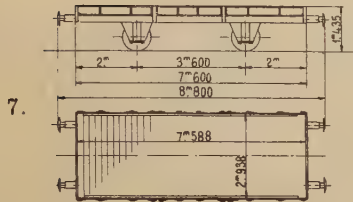


30-ton high-sided wagon.



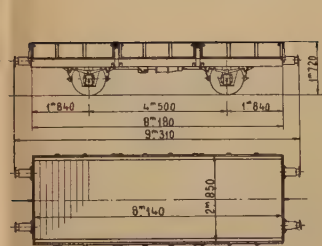
10-ton wagon.

North of Spain Railway.

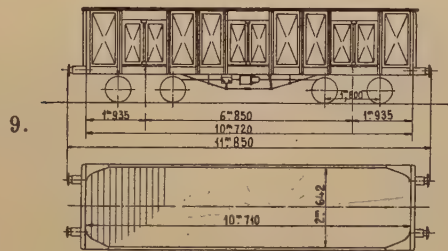


20-ton flat wagon.

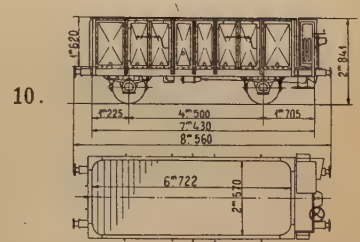
French Railways (standard types, O. C. E. M. designs).



Flat wagon, NNTouw.

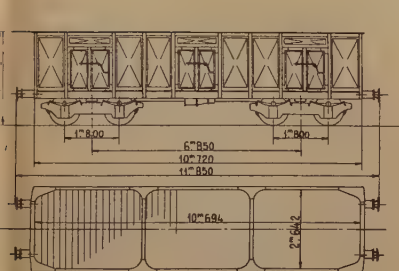


High-sided wagon, TTyw.



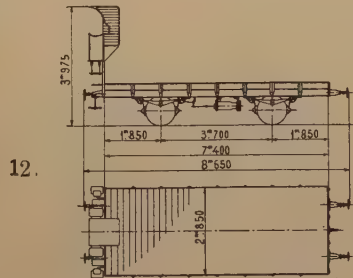
20-ton high-sided wagon, TTUwf.

French Est.



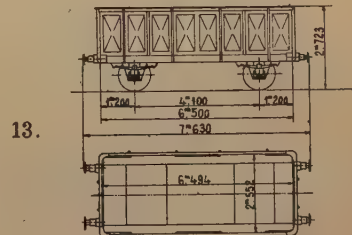
40-ton high-sided wagon, Tyw³.

French Midi.



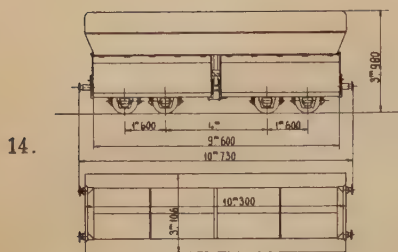
Flat wagon, Jrwf.

French Nord.

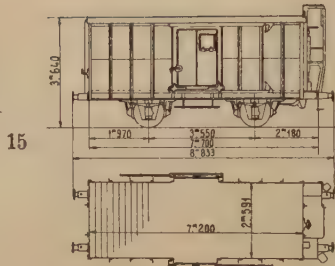


20-ton high-sided wagon.

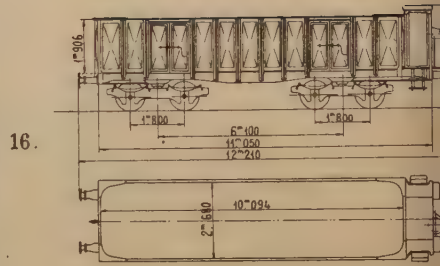
French Nord.



60-ton self-discharging wagon.

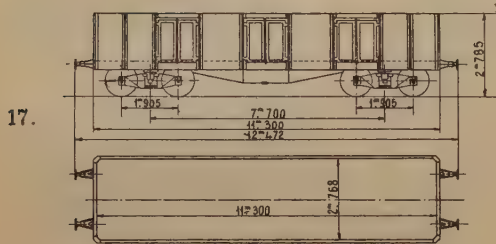


20-ton covered wagon, KKzf.

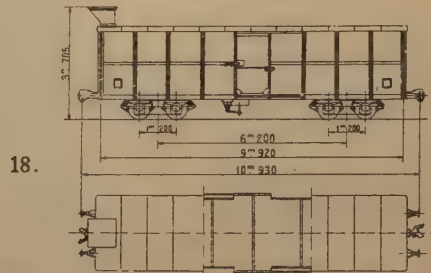


40-ton high-sided wagon, TTyf.

Paris-Orleans.

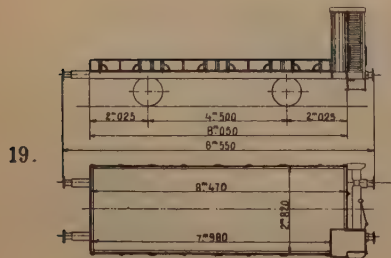


40-ton coal wagon, ITx.

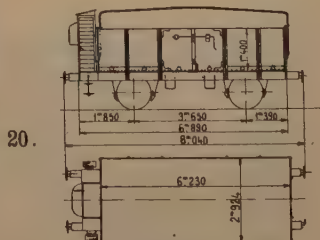


20-ton covered wagon.

Italian State Railways.

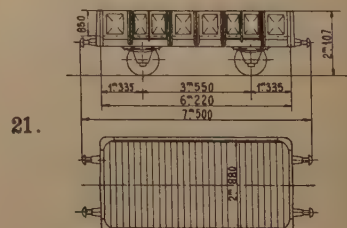


20-ton flat wagon, P type.



22-ton high-sided wagon, Ltm type.

Prince Henri Railways (Luxemburg)



20-ton mineral wagon.

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

XIIth SESSION (CAIRO, 1933).

QUESTION VII:

Allocation of freight rolling stock. Investigation into the turn-round of goods vehicles. Separation of the elements included in it. Methods of reducing the period of turn-round.

REPORT No. 3

(All countries except Belgium, Spain, France, Italy, Portugal and their Colonies; Luxemburg, Switzerland, Germany, Denmark, Finland, America, Great Britain, Dominions and colonies; China, Japan, Sweden, Norway; Netherlands and Colonies),

by J. DOLINAR,

Conseiller supérieur et Chef du service de la répartition du matériel
des Chemins de fer de l'Etat yougoslave, Belgrade.

A. — Allocation of freight wagons.

The wagon control department of the railway is responsible for placing at the disposal of the public the vehicles required to carry goods and cattle. This department must in consequence know exactly the total amount of rolling stock available for use at any moment, as well as the number of wagons needed, and allocate with judgment the available rolling stock which it must take the greatest care to see is used again in the most rational manner.

To the questions concerning the organisation of the wagon control department, we have received replies from the Egyptian, Bulgarian, Greek, Yugoslav, Polish, Rumanian, and Czechoslovakian State Railways; from these the information given below has been extracted.

I. — Definition of the problem of allocating wagons.

As public transport undertakings, the railways are obliged to accept goods for carriage and to put at the disposal of the consignors the number of wagons needed as far as they can. The only exception to this rule is in the case of dangerous goods, which on account of their nature cannot be loaded into railway vehicles. The wagons asked for are usually put at the disposal of the consignors the same day. The wagons are supplied in the order in which the requests are received. Priority is, however, given to wagons for carrying cattle, perishable goods, goods for a steamer or for export, and other urgent consignments for public reasons.

The wagons are demanded for a given

day, verbally, by letter, by telephone, or telegram. As a general rule the clients ask for them to be available for the next day or the day after. Each request should indicate the day the wagon will be loaded, the number of wagons required, the class of goods and approximate weight of the consignment, and the destination station. In asking wagons for the carriage of cattle, instead of the weight the kind and number of the animals to be carried must be indicated.

Customers have no right to require wagons of a certain tonnage or area, or wagons of special types to be supplied. Nonetheless, requests for the supply of such wagons are met as far as possible.

In each station the demands coming in are noted by the stationmaster, or by an employee authorised to do so, in a register provided for the purpose. On some railways, demands made verbally are written down by the consignors themselves, in the register of wagon demands; other administrations give on request receipts of the demands made. The type of wagons asked for is decided by the railway, if need be in agreement with the customer.

On the Egyptian, Bulgarian, Greek and Rumanian Railways, for each wagon demanded a deposit as fixed by the rates has to be paid. This payment is retained by the railway if the consignor does not load the wagon asked for and supplied. The other railways do not ask for any fixed deposit when a wagon is asked for except in the case of consignors not known at the station of those who cannot produce the necessary guarantees. On the Rumanian Railways, the consignor when asking for a wagon must at the same time produce the waybill; this last is used as a proof that the interested party will actually load the wagon asked for. The only consignors not required to make a deposit are those who have entered into special contracts with the railway.

Each railway has a sufficient stock of goods wagons to be able to meet fully all normal needs. The statistics of the number of wagons loaded per day, on the average, on the majority of railways, show that open wagons are principally used, which indicates that the goods principally sent are those which according to the schedule of rates are to be carried in open wagons. From the point of view of the loading and unloading stations, the railway companies can be arranged in two groups: the first includes the railways who have a larger number of loading stations, and the second those on which the unloading stations predominate; in fact the number of stations where the average number of wagons sent away and received is uniform is proportionately the same on all the railways.

As far as the goods traffic itself is concerned, in the case of the Bulgarian, Greek, Yugoslav, Polish, Rumanian and Czechoslovakian Railways, the period between the beginning of December and the end of November can be divided into three main periods: light traffic, average traffic and heavy traffic. The goods traffic is small from the beginning of December to the end of May; in June and July and also in a part of August it is average, while in the months of September, October and November the goods traffic can be said to be heavy; in October it reaches its greatest intensity. During these three latter months, in addition to sending coal and wood of all kinds agricultural produce, among which the beetroot traffic must undoubtedly be considered the most important, is sent by the railway.

On the other hand, on the Egyptian Railways the year can be divided from the beginning of September to the end of August into three periods as follows: during the first period, from September to the end of January, the railways carry chiefly cotton and cereals; during

the second period from March to the end of May onions are carried, while during the months of June, July and August, i. e. during the period of small traffic, it is especially coal and other daily traffic that is handled.

During each of these periods, the goods traffic increases uniformly up to its maximum point, to fall off, always in a regular manner.

II. — Solution of the problem of allocating goods wagons.

The organisation responsible for allocating wagons is required to see that the wagons, whether belonging to the railway or not, which are available after unloading, are sent to the point of re-loading in the most suitable way, so that the number and length of the empty runs shall be reduced to a minimum, and at the same time the actual needs of all the stations shall be met.

From the point of view of the organisation of the wagon allocation services, the Administrations mentioned above may be divided into two main groups :

The first group includes the Administrations who have only a wagon control service at headquarters. In the second group may be placed the Administrations who have a main wagon control office at their general headquarters, and at their operating managements or inspectorates, wagon controllers, having under their orders wagon allocation offices attached to the train working inspectorates, or if need be to the large stations. On these latter railways the central wagon control distributes the wagons between the wagon control offices at the operating managements or inspectorates which, according to the organisation adopted by the different administrations, either distribute the stock to the different stations or divide up the wagons between the different wagon sub-control offices placed under their orders, these latter then assuring the

distribution of the rolling stock to the stations along the lines assigned to them. Finally the stations allocate the wagons directly to the users.

As the supply of wagons required to carry goods and cattle is the principal task of the railway and as goods of all kinds are sent away daily by rail, the wagons must be placed at the disposal of the public each day, and consequently their allocation must be made daily. In order, however, that this allocation may be arranged and carried out in an equitable and economic manner, as well as in the interests of the administration, the wagon control office must be informed every day — on some railways Sundays and holidays are excepted — at a given hour of the wagons on hand at each station, and of its requirements.

This information should be supplied by telegraph or telephone to the wagon controller concerned. For this purpose all the stations are obliged to note in a register, at a given hour of the day, by number or by classes, all the wagons available on their sidings, grouping them by destination.

By available wagons is understood : a) in the destination stations all the wagons received in these stations to be loaded or off-loaded or disinfected — if these stations are at the same time disinfecting centres — or which are standing there in reserve; and b) in the intermediate stations, all the wagons cut off the trains for partial or complete off-loading, weighing, reloading, alteration or securing of the load, customs formalities or reconsignment. The wagons are then entered into the daily wagon returns in accordance with these particulars.

After having drawn up the wagon returns, the stations are obliged to advise the wagon control as to the total stock available at a specified hour, mentioning separately empty wagons and the wagons usually required for the next

working day, by means of the wagon demand register. This advice also gives: the possible surplus of wagons provided and not yet sent away, the probable number of spare wagons, the number of repaired wagons leaving the shops empty the same day. On some railways, wagons loaded but not yet sent away and wagons provided for loading are also reported.

Besides this main report, the stations where trains are formed have to let the wagon control concerned know by telegram or telephone the make-up of these trains. In these analyses of the trains, mention must be made of all wagons, whether belonging to the railway or not, which leave loaded and which are destined to be unloaded at stations on the railway, as well as foreign wagons returning home empty. On some railways wagons earmarked by the control when sent away are also reported.

The particulars of the wagons and the make-up of the trains sent by the stations to the wagon control offices form the principal rolling stock return sent to the wagon control headquarters. The situation of available wagons is also completed by the wagon controllers who add to it wagons arriving, i. e.:

a) the wagons whether belonging to the railway or not, which experience shows will arrive under load and which can be used to meet the next day's needs;

b) empty wagons belonging to the railway which experience shows will be returned by the lines in correspondence through the junctions; and

c) wagons allocated in excess, when dividing them up the previous day, which have not yet arrived, and for the use of which the control organisations have not yet given any instructions.

The total number so arrived at, in which a distinction is made between the total number of wagons belonging to the railway and that of those belonging to other railways which can be

used, the total number of empty wagons, the total number of usable wagons belonging to the railway and foreign wagons which are counted as arrivals, is communicated at a given hour, with the wagon needs, by the wagon controllers to the headquarters of the allocation service.

After having received the reports of all the wagon control offices, the central wagon control proceeds to « compensate » the available stock. This operation includes all the measures that the central wagon control has to take in view of the general wagon situation as well as the local conditions in the different districts. The allocation of the stock by districts is usually carried out in stages, from district to district.

The « compensation » of the stock is notified by telegram and sent as an urgent message.

The control offices are required to carry out immediately the distribution ordered. If this cannot be done, the control must include it in the next allocation and take it into account when giving particulars of the stock.

The communications sent with the « compensation » are also notified as complementary to the distribution of the wagons. The wagon controls are authorised to take what steps their local wagon situation requires at the time; in this case the head wagon office is advised after the event.

The distribution of the wagons is carried out with due attention to the economic side of the question. Cross working of empty wagons of the same type is avoided; long runs, especially over lines where the traction costs are high, are reduced as much as possible. In addition the train times and the local conditions are taken into account.

In order that the needs of the stations shall be met as quickly as possible, and to improve the turn-round of the stock, the trains by which the wagons allocated are to be sent are shown in the

working time tables. The allocation of wagons is made known to the stations at the stated hour by telegraph or by telephone. Each station must be able to understand from the distribution order of the stock what are the wagons in question and where they are to be sent as well as whence they will be received.

As we have mentioned on several occasions, the stations and the wagon control offices communicate between one another by telephone and by telegraph. For this the Morse and Hughes system of railway telegraph is used.

The count of the wagons and the wagon advice are generally dealt with during the morning, whereas the « compensation » of the stock and its distribution are done early in the afternoon. On the Yugoslav Railways the wagon position and the notification of the stock available, the « compensation » and the allocation of the wagons have been dealt with for the last two years during the evening and night. This measure has made it possible to work in more closely with the train service on the different lines and up to the present has given very good results.

The stations are not allowed to use, for other purposes, wagons put at their disposal without the approval of the wagon control concerned. After having carried out the instructions, the stations are allowed by some administrations to use the rolling stock remaining over or which is received without instructions from the wagon control, so far as these wagons have not been earmarked in some other way when allocating the wagons. The use of these wagons is controlled either by means of the daily statements, in which they are mentioned separately or by special returns. In the other administrations the wagons belonging to the railway system cannot be used without the authorisation of the wagon control concerned; on the other hand foreign wagons returning empty to their railway, which are used in ac-

cordance with the agreements, can be taken out of the trains and reloaded. Some railways allow wagons available to be dispatched under load to the stations for which they are intended in the wagon allocation. In this way, in any case empty running is avoided, which is advantageous unless these available wagons are required for urgent use and cannot be held back in the intended dispatching stations.

The standing orders dealing with the dispatch of empty wagons to certain stations only exist on certain railways and refer either to wagons of all classes, or to wagons of certain classes only, or these standing orders are only issued for certain periods. If the standing orders relate to wagons of all classes the intermediate stations can cut out and use the empty wagons being sent to the concentration yards. When these stations have need of wagons they should address themselves to these concentration yards. If the standing orders only relate to certain classes of wagons, for example to coal wagons or wagons marked « to be returned to the point of loading », such wagons cannot be cut out of the trains and used without the agreement of the wagon control concerned. These standing orders are checked every 10 days, every month, or every three months.

As regards foreign wagons, some railways do not use them when the wagon position is favourable, but return them empty to the owning railway as soon after they are unloaded as possible, whereas other railways use returning foreign wagons to some extent, in accordance with the agreements.

The whole of the administrations are of the opinion that the rolling stock should be standardised as far as possible, but they are not in agreement as to the tonnage of the wagons. Some Administrations consider that the covered wagons should carry 15 and 20 tons, others prefer for such wagons a ton-

nage of 17 to 20 tons, while others would like covered wagons of high capacity. As regards open wagons, the Administrations consider that the high-sided wagons should have a tonnage of 15, 20 and 30 tons, flat wagons, a tonnage of 15, 20, 25, and 30 tons, and these two classes a useful length of 25 m. (82 feet). The standardisation of the rolling stock is, however, hardly practical, as the consignors are continually putting forward to the railway Administrations new demands on the subject of the types of wagons, which must sometimes be taken into account.

As regards private owners' wagons, *all the Administrations* state that they are not in favour of them, except when a special type of wagon is in question. The present stock of wagons of private firms registered by each administration may be taken as being sufficient.

The whole of the Administrations agree in thinking that no railway should have a larger stock of wagons than is absolutely necessary; so large a stock could only be used during periods of intense traffic. As this period only lasts two or three months, the excess wagons have to remain unused in the yards the whole of the rest of the time.

When the stock is greater than is really necessary, the haulage of empty wagons can be reduced it is true (to suppress it is practically speaking impossible); but on the other hand, the cost of repairing too large a stock of wagons is greater than the cost of hauling empty wagons.

In the section dealing with the turn-round of goods wagons we will look more closely into the steps the administrations take when there is a shortage of wagons. We will content ourselves for the moment with noting that at these periods all the Administrations use foreign wagons to a great extent. Two years ago, the Yugoslav Railways introduced the system of allocating the rolling stock twice a day during the

heaviest traffic period, that extending from the 1 September to the 31 December. The first allocation takes place towards midday and the second during the night. This new organisation has given good results.

As regards storing the wagons over and above requirements, only the Polish Railways have introduced a definite scheme. According to this scheme the wagons are stored in the following order in the stations set aside for storing excess wagons: first of all the new wagons, then wagons which have still to go at least a year before heavy repairs, and thirdly wagons leaving the shops after repair. When the requirements cannot be completely fulfilled, the wagons in store are brought into service in the opposite order in which they were put into store. Before being put back into working these wagons naturally are gone over and lubricated. The period between heavy repairs is increased by the time the wagons have been in store.

On the other railways the excess wagons are stored in suitable yards; care is taken to select for this purpose yards whence the wagons can be sent most quickly and easily to the stations needing them.

As regards providing loading and load securing gear belonging to the Administrations when needed, the requirements are reported and the allocation made in the way laid down for the wagons.

Some Administrations have set aside certain yards as depots to which loading and load securing gear shall be sent after use, to be stored. On the other railways this gear is left at the stations at which it is received with the loaded wagons until again required.

As regards the different loading and load securing gear used, the following which are the most important: chains, stanchions, sheets, and crates for con-

signments of vegetables and fruit, must be mentioned.

In order to facilitate their identification, some railway Administrations have numbered not only the sheets but also other loading and load securing gear.

The wagon service in the rolling stock control offices is covered by senior employees who in each Administration have passed the practical examinations laid down and have been engaged in the stations over a long period in the train working and in the commercial service. On some Administrations the stock is allocated by former stationmasters and their assistants, or by employees who have previously followed special courses at headquarters.

As in the general interest the wagons asked for must be supplied without delay, the wagon distribution service is covered more or less continuously, so that if late demands are made by the stations, the required wagons can be supplied at any time.

III. — Control of the execution of the allocation orders.

The wagon control offices make sure that the orders allocating wagons have been carried out, either by means of special telegraphic advices, or by telegraphic notification of the situation, and by written stock statements; in addition, the carrying out of the distribution orders is checked by the actual control carried out by men of the rolling stock and train working services.

If the execution of the distribution orders is checked by means of special telegrams, the stations have to send these notices to the wagon control office immediately after the wagons concerned have been sent away. In cases in which the wagons allocated pass through several regulating stations, the latter should also record to the control

offices concerned, the times these wagons pass.

If the carrying out of the allocation orders is controlled by means of the telegraphic advices of the situation and by written stock statements, the stations must add, to the daily telegraphic advice, the stock position of the rest of the wagons allocated, divided by number, classes and destination stations. In addition, the wagons allocated are also reported as such in the train analyses. Some railway Administrations, in the case of the goods trains, get out special lists in which the wagons are entered by owner, number, classes, state (empty or loaded), dispatching and destination stations. These statements, which are considered as an addition to the time sheets, are submitted by the regulating stations to the wagon control concerned, so that the orders distributing the stock can be checked. In these Administrations all the stations also have to keep special returns showing the way these orders have been carried out. These returns are verified by actual checks. On other railways the wagons allocated are sent with waybills got out in triplicate. The original remains at the dispatching station, a copy accompanies the wagon allocated to the destination station, while the second copy of the waybill is sent in advance by passenger train to the destination station.

When carrying out the distribution orders, the empty wagons in the stations must first of all be used, as for reasons of economy it is absolutely necessary that the distribution orders should be carried out as quickly as possible. In the case of wagons sent to distant stations, all railways send them by trains made up for the purpose, or if this is not possible by the most suitable trains. The responsibility for properly carrying out the wagon allocation orders falls on the stationmasters, or in the large sta-

tions, on the men responsible for looking after the wagon service as a whole.

The wagons about which the wagon control concerned has already given its instructions can in no case be used otherwise unless it assents. In the same way the stations are not allowed to shunt off the trains an empty wagon which has been allocated, nor add empty wagons belonging to the railway without an order from the wagon control concerned. Foreign wagons returning empty to the owning railway can only be cut out of the trains if they can be used in accordance with the agreements.

The economical utilisation of the wagons and of the trains is checked by the aid of the rolling stock returns and the time sheets, as well as by the actual control the men of the rolling stock, train movements and commercial services carry out in the stations. The Polish State Railways grant, for the rational and economical utilisation of goods trains, special premiums which are arrived at from the statistical data available. In the case of shortage of wagons the active check as to the best possible economical utilisation of the wagons of the railway as well as of the foreign wagons is carried out with greater severity.

The execution of the wagon distribution orders as regards loading and load securing gear belonging to the railway system is generally checked in the same way as that of the wagons themselves. In addition the stations keep special stock lists of the loading and load securing gear, by which it is possible to check at any moment the dates of receipt and dispatch. Copies of these statements are submitted every month to the wagon control offices concerned.

B. — Turn-round of the rolling stock.

All the administrations agree that the most careful attention must be given to

the turn-round of the wagons. The consequence of getting a rapid turn-round of the wagons is that a numerically smaller stock can carry the same tonnage of goods as the larger stock required when the turn-round is slow.

The turn-round of the stock is generally calculated on the basis of the time between two successive loadings of the wagon. This average time is expressed in days and is usually ascertained by dividing the number of wagons loaded in a given period by the average number of wagons supplied during the same period. The number of wagons under repair or away on other systems, as well as the number of wagons reported each day as in excess, is subtracted from the number available. Some administrations add to the number of wagons loaded on their own lines, the wagons which during the same period they receive under load from neighbouring administrations for through transit. Other administrations on the other hand adopt as the basis of calculation of the turn round of the rolling stock the time the wagons take to cover a distance of 500 km. (310 miles) or to travel from the loading to the unloading station.

The Rumanian State Railways calculate the turn-round of the rolling stock by means of the following formula :

$$K_1 + K_2 = \text{the average turn-round time} \\ + \text{the average standing time.}$$

Method of calculation. Let :

- a = the number of loaded wagons ;
- b = the number of wagons which have been received loaded at a frontier station ;
- $c = a + b$ = the total number of loaded wagons ;
- t = the number of empty wagon-kilometres ;
- u = the number of loaded wagon-kilometres ;
- m = the number of goods train-kilometres ;

l = the number of actual running hours of goods trains;

i = the total time standing of all wagons.

We then get :

$\frac{u}{c}$ = average distance run at each loading by a loaded wagon (in km.);

$\frac{t}{c}$ = the average distance run at each loading by an empty wagon (in km.);

$$M = \frac{28, 30, 31 \text{ or } 365 \text{ days}}{K} = \frac{\text{number of days per month or per year}}{K}$$

Example :

a = 3 679 691 axles per annum;

b = 102 902 axles per annum;

c = 3 782 593 axles per annum;

i = 31 801 488 axle/days per annum;

$$\frac{u}{c} = 256.30 \text{ km.};$$

$$\frac{t}{c} = 145.32 \text{ km.};$$

$$j = \frac{t + u}{c} = 401.62 \text{ km./hours.}$$

We then get :

$$K_1 = \frac{j}{v} = \frac{401.62}{287.76} = 1.39 \text{ days.}$$

$$K_2 = \frac{i}{c} = \frac{31\,801\,488}{3\,782\,593} = 8.41 \text{ days.}$$

$$K = K_1 + K_2 = 1.39 + 8.41 = 9.80 \text{ days;}$$

$$M = \frac{365}{9.80} = 37.24.$$

This method of calculating the turn-round of the rolling stock makes use of the special waybills which accompany the wagons.

The turn-round of the rolling stock is calculated each month and each year, generally for the whole of the goods wagons. Some Administrations calculate it separately for the covered wagons, flat wagons and high-sided wa-

$j = \frac{t + u}{c}$ = the average distance run by a wagon from one loading to the next loading (in km.);

$v = \frac{m \times 24}{l}$ = the running speed of the goods trains per day (in km./days); whence :

$$K_1 = \frac{j}{v} \text{ (in days);}$$

$$K_2 = \frac{i}{c} \text{ (in days);}$$

gons; others make a distinction between the different classes of wagons and between the wagons belonging to the railway and those of other railways.

In order to obtain a quick turn-round of the rolling stock, the Administrations have adopted different measures, among which the following may be mentioned : getting out good train working diagrams for the through accelerated goods trains and the ordinary through goods trains, with only absolutely necessary stops at the intermediate or junction stations; if need be, running extra trains; speeding up the shunting in the stations as much as possible; continuous use of suitable measures for speeding up the unloading of the wagons by the customers, such as, in particular, imposing regularly the penalties for delay laid down in the schedules; putting the wagons into place several times daily for off-loading or loading; and an active control by the train service and the commercial service staff of the way the work is done.

In periods of wagon shortage, the above mentioned measures may be strengthened by the following : reduction of the period allowed for unloading and loading; increase in the penalties for delay extension of the working hours or the introduction of night work in the goods sheds, especially in the sta-

tions where the goods traffic is considerable; the use of covered wagons in place of open wagons for goods which, in accordance with the schedule of rates, should be carried in open wagons.

This last measure is also adopted by several Administrations during the normal period, in order to reduce the empty wagons running to a minimum.

The average speed of goods trains fitted with hand brakes is 30 to 45 km. (18.6 to 28 miles) an hour. On some railways, however, goods trains conveying express and perishable goods run at a speed of 50 to 60 km. (31 to 37 miles) per hour, although the wagons in them are only fitted with hand brakes. The average speed of goods trains with continuous brakes is 60 to 70 km. (37 to 43.5 miles) per hour. All the Administrations are taking steps to equip as soon as possible all their goods vehicles with continuous brakes, in order to be able to increase the speed of goods trains.

Wagons loaded with express parcels traffic are generally attached to passenger trains. According to the momentary traffic conditions, wagons loaded with perishable food stuffs, such as : fresh meat, vegetables, and fresh fruits, even when these goods are sent by ordinary goods service, are attached to passenger trains.

Wagons loaded with parcels for ordinary conveyance for long distances are marshalled in through goods trains, unless the Administrations have adopted for the rapid conveyance of these goods special light goods trains (« Leig » trains) which are formed of a given number of covered wagons of large capacity specially fitted out for this work and fitted with continuous brakes. Trains of this kind sometimes reach a speed of 70 km. (43.5 miles) per hour.

The periods for loading and unloading wagons vary, according to the conditions of each country, from 6 to 24 hours for the same work. The Ad-

ministrations who have made provision in their schedules in normal times for the periods of 10 and 24 hours for unloading and loading respectively, reduce it to 6 or 8 hours during the time of wagon shortage. For the double operation, the periods are generally calculated separately for unloading and for loading the wagons. When fixing the period of unloading and of loading at 6, 8, 10 or 12 hours, only the normal working hours are taken into account, whereas when the period for loading and unloading is fixed at 24 hours it is calculated continuously. At the end of these fixed times, the penalties for delay laid down in the schedules are imposed, these being either calculated on a progressive scale, or especially laid down for certain stations. Sundays and holidays are only included in the calculation of the penalties for delay when the period of unloading or loading for the wagons in question expired on the Saturday or the eve of the holiday. The number of wagons which are not off loaded or loaded within the time laid down represent 3, 7.5 and 15 % of the total number of wagons put in place for unloading and loading. No premiums are granted for the accelerated loading and unloading of the wagons.

The consignees of the wagons received under load at the stations are advised by writing (by post or messenger), telegram or telephone. This notification is generally sent after the wagons have arrived. During the periods of stock shortage alone, some railways advise the consignees of loaded wagons before their arrival at certain stations. In this case the waybills are sent in advance to the unloading station by stopping or express passenger train. As regards the consignors, they are not generally advised that the empty wagons are put in place for loading. The hours the goods sheds are open are notified to the consignors by public notices posted up in the stations.

In order that, at the periods of heavy goods traffic, and especially during the autumn season, all wagon demands can be met in sufficient time, another precaution is taken besides the measures mentioned above, this consisting in the Administrations suspending entirely during this period the transport of service materials or else reducing them to the absolute minimum. In addition, for stations or lines having an exceptionally heavy wagon movement, special instructions are got out according to which these stations are asked not to accept more than a certain number of demands corresponding to that of the wagons which can actually be loaded and sent away during the day. If the Administrations possess in certain stations cartage undertakings, these are obliged to distribute the goods received to the consignees several times daily; these deliveries should take place more frequently at these periods than when the goods traffic is normal.

C. — Conclusions.

Each Administration should enable consignors to make their demands for wagons in writing, verbally, by telegraph or telephone; they should in addition take steps to see that, when the requests are made in writing, specially printed forms are used. The register of wagon demands should be kept as a general rule by the station master. Private individuals should not be authorised to have access to this register. As a rule no deposit should be required for demands for wagons except in the case of users not residing in the locality and not deserving credit.

It is desirable that Administrations controlling a railway system with many branches should organise, besides the central wagon distribution service at headquarters and the wagon controls at the area managements or operating inspectorates, wagon distribution offices

in the large stations from which several lines start, or in the stations which in themselves constitute a traffic centre so that the distribution of wagons over the lines under these offices shall be carried out with the greatest speed and the wagon service shall be carried out under constant supervision.

To facilitate reciprocal communications, all the stations must be connected to the wagon control office concerned, either by direct telegraph line which, at the time that the wagon situation and the distribution of the wagons is being reported, must not be engaged on other transmissions.

In addition, all stations of some importance should be connected to their wagon service by through telephone lines.

In the same way the wagon control offices should be connected together by through telephone lines, so that all questions requiring attention can be settled as quickly as possible.

The stock of wagons should as a rule only be got out by classes of wagons. The statement should be prepared by the station master or in the larger stations by the head of the goods service, unless some other employee of the station is specially responsible for doing the work.

Every time the train workings are changed, the wagon control offices should indicate in advance the trains the composition of which should be reported to them. These train analyses should be drawn up very accurately and be sent by telegraph as quickly as possible, as they form an essential factor in the available wagon position and largely contribute to preventing useless empty mileage.

Whatever the wagon position may be, it is desirable to use foreign wagons as much as possible, without paying attention to the resulting increase of hiring charges to be paid, as the cost of

haulage of empty wagons is much greater than the hire to be paid.

To manage the wagon allocation services, capable senior operating employees perfectly familiar with the traffic working on the lines over which they are called to carry out the wagon distribution, must always be selected.

All documents dealing with the carrying out of orders relating to the allocation of wagons and the utilisation of the stock must be checked each day by the wagon control offices and any serious defects corrected.

The active control, which should be carried out constantly, should always

be confided to men with the necessary qualifications.

The turn-round of the stock should be calculated in such a way that the times the wagons have taken first of all in the loading stations, then while running between the loading and unloading stations, and finally in the unloading stations themselves, as well as the time taken between the unloading station and the reloading station are known. Such information will make it possible to know why the wagons lose a relatively excessive time in such and such a station or on such and such a line, and how the defective working revealed can be remedied.

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

12th SESSION (CAIRO, 1933).

QUESTION X :

Instances of the application in a railway department of the scientific organisation of work. Co-operation of the staff towards increased efficiency and its participation in the profits.

REPORT No. 3

(Denmark, Norway, Sweden, Finland, Germany, Switzerland, Czechoslovakia, Bulgaria, Greece, Rumania, Jugoslavia, Turkey, Poland),

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Introduction.

Question X which will be discussed at the forthcoming Congress has already been debated at the following previous Congresses :

1. a) Under the title : *Question XI. — Premiums. What is the best premium system in connection with the repairs of rolling stock and locomotives?* it was considered at the Second Congress (Milan, 1887) when the discussion was summed up in the following motions :

It appears advantageous to compose the remuneration of the driving staff of locomotives — enginemen and firemen — of a fixed part, ensuring suitably their means of existence and their future, and a variable part, increasing with the personal work and the efforts of each with a view to giving a service satisfactory to the public, while being economical for the Companies.

b) At the same Session under the title : *Question XXI. — Payment of employees. What is the best method of paying the employees and of interesting them in the operating savings?* the approved conclusions were as follows :

The Congress admits that when, for any reason, the individual initiative cannot have free play, economy premiums and other institutions of a similar nature are to be recommended, on condition, however, that they are never obligatory and that all the measures to be adopted tend to disengage the Administrations from a supervision which is not without danger, and to develop the action of the co-operative societies, free from all direct interference from the Administrations, a desideratum to which our incessant efforts must tend.

2. Under the title : *Question XX. — Premiums to the staff. Means of interesting the employees in economies in*

the working expenses and in the increase of receipts, it was debated during the third Congress (Paris, 1889), the conclusions adopted being the following :

The meeting is of the opinion that outside of the means of a moral and material order (provident institutions, etc.) calculated to maintain the necessary bonds of solidarity between the Companies and their employees, premiums for economy, bringing into play their personal interests, are one of the best means for developing the efforts of the employees, in the direction of improving working results.

The meeting remarks, in the first place, the difference to be established between *bonuses*, properly so called, which recompense exceptional efforts or services, not susceptible of exact measurement, and *premiums*, which can be applied to economies realised on expenses which it is possible to evaluate more or less exactly. In this order of ideas, the assembly completely rejects the idea of premiums based on the development of gross receipts, by reason of the difficulty of determining exactly who are the servants who can influence such development, and above of all of measuring such influence.

Premiums based on the increase of net working receipts (and not on the increase of the dividend), after setting aside the capital charges, on which the operating services have no effect, would be less difficult to establish; it appears preferable to the assembly, however, by reason of the influence of the gross yield on the working receipts, to adopt here the form of a bonus, the total amount of which, determined by the Boards, would be distributed by the directors amongst the various operating services and by the chiefs of these services amongst the employees who may have been able to contribute to the increase of the net receipts.

With regard to operating expenses, the assembly considers that these comprise, in very large number, elements susceptible of more or less precise determination, either directly or by the results obtained in one or more previous financial years, and that for

all these elements it may be very advantageous to establish premiums based on the saving realised on a wisely determined allocation. The bases of these allocations must be revised from time to time, to take account of the results achieved, the share attributed to the employees in the savings realised having to be increased as the allocation is reduced.

The meeting considers that premiums allotted to aggregates too large in number are not advisable, the reciprocal supervision of the employees over each other becoming impossible. It thinks that the premiums must be direct, and paid so far as possible to individuals or to very small groups. It thinks it inadvisable to limit them in advance to a maximum; if they appear excessive, it is preferable to revise the bases of the allocations. It adds that, in order to produce their full effect, premiums must be credited to those entitled to them as soon as possible after the settlement of the operation to which they relate.

The meeting is of opinion, finally, that if, in the operating services, there are a very great number of elements susceptible of evaluation in advance and of premiums for economy based on a predetermined allocation, it is well to avoid those premiums which would be liable to compromise safety, and in particular only to apply them with prudent reserve to the service of permanent way maintenance, economies in this respect being possibly realisable by neglect of measures absolutely indispensable to safety and to the good preservation of the track.

3. At the IXth Congress (Rome, 1922), under the title : *Question XVI. — Workmen's dwellings*, the final conclusions adopted were :

It is desirable that each employee should have a healthy and conveniently arranged dwelling.

It is desirable that, when necessary, administrations should provide these dwellings for their employees.

With a view to arranging for this, it is in the interest of the administrations to act

with private societies (either with or without State assistance according to laws and customs of the various countries) whose business it is to build these dwellings, and to make the necessary financial arrangements with them for the purpose. It would also be an advantage for the companies to encourage the formation of building societies amongst their staffs.

It is desirable that railway administrations should take special care to provide suitable accommodation for those entrusted with work connected with the safety of the line and who are unable to find it in the immediate vicinity of their occupation.

Finally,

4. a) Under the title : *Question XVI. — Methods followed in training of staff, professional, technical and ordinary working grades*, at the XIth Congress (Madrid, 1930), the discussions being summed up in the following conclusions :

The information furnished in reply to the questionnaires indicates that staff instruction is well organised on the majority of the Railways.

1. Railway Administrations should take particular care to select candidates possessing the necessary qualifications for the posts to be filled. To this end, candidates should be required to pass an examination in general knowledge, or furnish a school certificate. Special examinations, including psycho-technical tests, should however, be instituted if necessary. Several Administrations have made use of such tests with very satisfactory results; their extension is recommended.

2. Preliminary instruction should be given before the appointees commence work. This instruction will, of course, vary in character and duration, for ordinary workmen, artisans and clerks. With this end in view, most of the Administrations have created institutions of a more or less perfected kind, particularly as regards apprenticeships. It is recommended that Administrations should take care to give their manual workers at

least as good a training as that afforded by other industries in their respective countries.

It is also recommended that all Railway Administrations in countries where military service is obligatory should give priority to their ex-apprentices who, on the termination of their military service, submit applications for employment in any posts that may be vacant.

3. In view of the information furnished by the various Administrations and the trials already carried out, it is recommended that employees should be given regular and methodical instruction in regard to new regulations, new developments in their respective spheres of work, and be taught to carry out their work economically (i. e., obviating waste of time or materials) punctually, and with safety to themselves, the public, and the rolling stock, etc. The employees should be required to serve probationary periods, either in technical schools, or by instruction at the stations, depots, etc., using travelling schools (wagons-écoles), magic lanterns, and the cinematograph. Good results have been obtained from instructional cinematographs, and their use is recommended.

It is strongly recommended that men who work alone should receive careful instruction, and further that practical training should be given as regards the steps to be taken in the event of accidents or other emergencies.

Furthermore, it is necessary to test the men from time to time to see that they have assimilated the knowledge imparted to them, and are making good use of it.

It is also recommended that support should be given, as far as possible, to private institutions which provide tuition for the men, and attention is drawn to the method of teaching by correspondence, which has been successfully adopted by some Administrations.

5. Finally, men of particular merit should have an opportunity of being tested in regard to their powers of judgment and ability to command, with a view to promotion to the higher grades.

b) During the same Congress under the title : *Question XV. — Participation of the staff towards increased efficiency and its participation in the profits*, the discussions resulted in the following conclusions :

The Fourth Section considers that, in spite of the efforts made by the Reporters, the information received from different Administrations on the subject of Question XV is not conclusive.

In these circumstances the Section suggests to the Permanent Commission that the matter be referred back for further investigation and inclusion on the agenda for the next Congress, in the following terms, and expresses the hope that the next Congress, by taking into account the data already received and the further information which will be collected, will be in a position to make suitable recommendations.

Participation of the staff in the results of working, under the various aspects of the problem of treatment during each year, with the view of enlisting the men's close and harmonious co-operation in obtaining the maximum output and furthering the prosperity of the undertaking, at the same time giving railway users the best possible transportation at minimum cost. Methods of any kind will be considered and particularly those hereafter :

1. Methods of interesting the staff in the partial or complete results of railway working.
2. Co-operation of the staff in the working of the undertaking (setting up sectional councils and suggestion schemes, etc.).
3. Methods of binding the staff to the railway service (social work, pensions, housing schemes, medical benefits, insurance, etc.).
4. Technical instruction.

In the way this question is now worded, it covers a multitude of problems, some of which have been treated with great competence by our eminent colleagues.

Below we mention the fully- docu-

mented preparatory reports submitted in 1930 to the XIth Congress, at Madrid.

A. On professional instruction.

Report by Mr. Barth (Belgium, France, Holland, Italy, Portugal, Spain and their Colonies). (See *Bulletin*, September 1929, p. 1905).

Report by Mr. L. C. Fritch (America, the British Empire, China and Japan). (See *Bulletin*, August 1929, p. 1315).

Report by Dr.-Ing. B. Schwarze (Germany). (See *Bulletin*, April 1930, p. 1197).

Report by Mr. Mereutza (all countries, except those mentioned above. (See *Bulletin*, August 1929, p. 1453).

B. On the methods of interesting the staff in the results, either partial or global, of the undertaking.

Report by Mr. C. C. Cook (America, the British Empire, China and Japan). (See *Bulletin*, July 1929, p. 1125).

Report by Messrs. Soulez and Bloch (Belgium, France and their Colonies). (See *Bulletin*, November 1929, p. 2533).

Report (other countries), by Messrs. R. Marin del Campo and J. Canovas del Castillo. (See *Bulletin*, January 1930, p. 215).

The questionnaire we sent to the railway companies followed the one drawn up by our colleagues Messrs. Soulez and Bloch so far as we considered it really complied with the desiderata formulated at the Madrid Congress.

In order to assist in bringing into full light the methods of each Administration for increasing efficiency by improvements in the general organisation of the services and the operating properly speaking, that is, to be precise, from the point of view of the progress accomplished in the scientific organisation of managerial and productive work, our questionnaire, besides the desiderata of the Madrid Congress contained three chapters reserved to the following questions :

1. Improvements made in the general

organisation of a group of railway systems or in a single railway system;

2. Improvements made in the working methods, equipment and tools;

3. Improvements carried out in the standardisation of rolling stock, of fixed plant, and of materials in general.

A reconsideration of these questions bearing as they do on the « rationalisation », « standardisation » and the « scientific organisation of work » becomes necessary when we observe that they are serious subjects of discussion at the present time in all branches of commercial and industrial activity and that special importance is attached to them.

These questions moreover are definitely before us for consideration in this age when there is a tendency to create a special and general science dealing with their subject, applicable to a great

number of industries, and when we take notice of the fact that for this purpose a special international association : « The International Institute for the Scientific Organisation of Work » has been set up at Geneva (a still young organisation, the future development of which depends upon the goodwill and assistance it meets, an organisation to which the general management of the Rumanian State Railways has thought it desirable to belong as member) and finally that in completing the questionnaire submitted to the Madrid Congress by these three supplementary questions the trend of the times is imprinted on Question X.

The replies received show that the idea of completing the Madrid questionnaire by these three chapters was not without use.

The following table gives the Administrations who replied to the questionnaire sent them.

List of Administrations who replied to the questionnaire.

Country.	Kilometres. (Miles).	Name of the Administration.
Germany	53 790 (33 424)	State Railway Company (Deutsche Reichsbahn-Gesellschaft).
Bulgaria	2 285 (1 420)	State Railways and Harbours.
Poland	17 241 (10 713)	State Railways.
Rumania	11 616 (7 218)	State Railways.
Sweden	6 641 (4 127)	State Railways.
Do.	300 (186)	Grängesberg-Oxelösund Railway Company.
Switzerland	2 942 (1 828)	Federal Railways.
Czechoslovakia.	12 429 (7 723)	State Railways.
Jugoslavia	9 270 (5 760)	State Railways.

The replies of the Railway Administrations to the questionnaire sent them are summarised below and we will en-

deavour after dealing with them and in way of conclusion to bring out the instruction they contain.

II. — Replies of the Railway Administrations to the questionnaire.

PART I.

CHAPTER I.

Improvements effected in the general organisation of a group of railway systems or of one system.

Rationalisation.

QUESTION No. 1.

General organisation of a group of railway systems, concentration, grouping.

Is your railway the result of a grouping or of a concentration of preexisting systems?

If yes, what were the reasons that decided this grouping?

Replies.

1. — Germany: German State Railway Company.

The German Railways are the result of the union of the railways of the following states:

Prussia, Bavaria, Saxony, Wurtemberg, Baden, Hesse, Mecklenburg-Schwerin and Oldenburg.

These railways, previously autonomous, were transferred by agreement to the property of the Republic. The reasons for this concentration were economic, administrative and operating.

2. — Czechoslovakia: State Railways.

Grouping of preexisting railways as a result of the revolution of the 28 October 1918.

The railways of Austria and Hungary on the territory of the Czechoslovakian Republic passed into the ownership of the Republic.

The new political conditions and the new orientation of the traffic made it necessary to reconstruct certain lines.

The old Austrian railways become the new Czechoslovakian were largely the result of the State taking over private railways. This policy has been continued in Czechoslovakia so that at the present time most of the railways belong to the State, the proportion being 83.86 % of a total of 13 231.913 km (8 202 miles).

3. — Rumania: State Railways.

The present Rumanian Railways include the old Rumanian State system, which administration at the end of the war took over the Transylvania railways belonging to Hungary prior to the war, the Bukovine railways previously belonging to Austria, and the Bessarabia railways formerly belonging to the Russian State. The same thing occurred as regards some small private railway undertakings in these provinces.

4. — Switzerland: Federal Railways.

The Federal Railways are formed by the union under the Confederation of the five most important private companies. The principle on which this operation was based was given in the law on the repurchase of the railways of 1898. The private railways were not bought out by means of concessions as the law provided but by arrangements come to between the State and the Companies.

In order to justify the nationalisation of the railways which raised a widespread hostile political campaign, the reasons on which emphasis was laid were especially in connection with public economy and military needs. The private companies were in fact run partly on foreign capital and this might have been dangerous from the point of view of national independence.

5. — Poland: State Railways.

The Polish State system is the result of a grouping of three systems formerly

belonging to the German, Austrian and Russian States. These systems have been brought together in order to get unified operation and administration.

6. — Bulgaria : State Railways and Harbours.

The State Railways are the result of concentrating preexisting railways, namely the State lines built between 1885 and 1909, and the Oriental Railways purchased in 1909, a concentration carried out in order to unify both the operating and administrative services.

7. — Jugoslavia : State Railways.

The Yugoslav system is the result of grouping preexisting systems. The reasons for combining the systems were administrative.

8. — Sweden : Grängesberg-Oxelösund Railways.

The Swedish system is the result of grouping together three preexisting systems, the object of this concentration being the rationalisation of transport over the said railway systems.

QUESTION NO. 2.

Describe the general organisation of the system.

What organisations are included in the management properly speaking?

What are the special measures taken to ensure liaison between the various services?

How is the budget of receipts prepared?

How is the budget of expenditure prepared?

How are the receipts and expenditure in the current year controlled?

Replies.

1. — Germany : German State Railway Company.

The managing authority is the headquarters administration (Hauptverwal-

tung) at the head of which is the general manager assisted by 8 managers. The work of this headquarters staff is controlled by the board of advisors (Verwaltungsrat), the supreme authority of the railway. The collaboration between the different services is assured to the extent that all questions are sent for enquiry to all the interested services who after considering them report either accepting them or suggesting modifications according to their views and the needs of the moment.

The budget includes :

- 1) the operating accounts, and
- 2) the investment or capital accounts.

Starting from 1930, these accounts have been classified according to the nature of the expenditure and of the receipts (industrial accounting).

The estimation of the receipts is made on the results of the preceding years and after allowing for any probable modification in the receipts during the year's working.

When getting out the preliminary expenditure account the real needs are used as the basis.

The receipts and expenses are checked against the monthly reports of the departments which, by preparing quarterly statements, thereby show the requirements for the rest of the year's work.

2. — Czechoslovakia : State Railways.

The supreme authority, the Ministry of Railways with its eight sections each divided into several services, has as its head the Minister of Railways who controls the business assisted by :

a) the administrative council, composed of 12 members at most, one of whom representing the Ministry of Finances, the others being civil servants in the Ministry of Railways or independent experts;

b) the permanent commission of in-

spection, generally consisting of 3 members who may not be members of the administrative council at the same time. One of these represents the Ministry of Finances, the two others are civil servants in the Ministry of Railways. This commission has a special rôle (financial control); it has no executive power, but exercises an effective control through the regular control channels. It submits its reports to the Ministry of Railways and the Ministry of Finances, and to the administrative council and so is able to call the attention of the Ministry of Railways and the administrative council to irregularities additional to financial ones noted during the course of its activities.

The eight area managements of the railway under the Ministry of Railways each consists of 8 departments or services, a clearing office, and a headquarters pay office. The 8 departments are the following :

- I. Staff, health, and matters affecting the welfare of the staff;
- II. General legal and administrative matters;
- III. Ways and works;
- IV. Traction and workshops;
- V. Rolling stock and traffic;
- VI. Commercial;
- VII. Receipts;
- VIII. Financial.

The budget of the undertaking from the point of view of the expenditure is divided into :

- I. Operating budget;
- II. Repairs budget;
- III. Capital budget.

I. The operating budget is divided in its turn into:

A) Service of the interests and sinking fund of the debt on the Czechoslovakian State Railways. This portion does not appear in the operating budget but goes into the profit and loss account.

B) Executive service, including the operating budget, divided up as between the different branches of the service.

This part of the budget also includes the sums belonging to the « suspense account » which after the expenditure provided for the operating properly speaking of the lines has been determined are afterwards distributed amongst the different departments according to exact proportions based on the principles given in the regulations governing the « suspense » account.

The repairs budget is provided with funds from the « suspense » account which takes care of the repairs whilst limiting the absorption of funds required for the operating properly speaking.

It should be noticed that the railway undertaking under paragraph 1, part (B), also bears the cost of its highest administrative organisation (the Ministry of Railways) to the extent that this is not met by its own funds.

To the operating properly speaking of the railway the following subsidiary undertakings are attached :

- Main workshops;
- Repair shops;
- Manufacture of tickets;
- Electric power stations;
- Gas works;
- Stores;

and in addition as auxiliary undertakings :

- Road motor services;
- Funicular railways.

The financial balance sheets of the shops, tickets works, power stations, gas works, road services, and funicular railways are dealt with in special accounts, and are balanced separately, so that the situation of these undertakings can be known accurately and their administration be subjected to close control.

Finally the results of the year's working are carried as credit and debit balances to the respective accounts of the

operating when taking out the general balance sheet of the undertaking.

II. The repairs budget makes provision for the expenditures required to maintain the buildings, lines and installations in their original condition or in the condition up to which they have been brought by later additions or improvements.

III. The capital budget (first construction costs) includes the expenditure on :

1. the operating properly speaking;
2. the auxiliary works;
3. the ancillary works;
4. the construction of new lines.

The capital costs are made good in part by the proportional part of the working profits, in part by the contribution by the State exchequer from the transport tax and, in unfavourable financial years, by a loan.

The operating receipts account includes :

- § 1. transport receipts;
- § 2. other receipts;
- § 3. interests and differences in the rates of exchange.

A section responsible for checking the receipts is attached to each area management of the Czechoslovakian State Railways.

The numerical accountancy control of the expenditure has been centralised since the 1 January 1925 in the financial sections of the area managements of the State Railways. Previously this control was exercised by the technical section, although it was the duty of the financial sections to carry out the counter checks. From the date mentioned, the numerical control is carried out solely in the financial sections (this control has been entirely abolished in the technical sections), and this is prescribed for the whole railway. As a result the offices in the financial sections checking the expenditures have

been provided with mechanical equipment, and in particular with :

a) Calculating machines, by means of which the employees check entries in all the horizontal positions against the data supplied by the services attached to them;

b) Electric adding machines which deal with all additions of payments, of deductions and of amounts to pay as well as of other accounts documents, the items of which are calculated vertically.

We note that there are two methods of payments, the definitive i. e. the payment of notes which are checked before payment by the expenditure checking office, and the payment checked subsequently, which payment is made against the particulars supplied by the executive services, i. e. beforehand, and is checked by the expenditure checking office only after the money is paid.

Besides the control of expenditure carried out by the management in the course of its activities, the expenditures and receipts are checked by the departments of the Ministry by means of the periodical check of the requirements and of the expenditures made, as well as on the basis of the statistics of the work done and the traffic density, and also according to the personal check carried out by the reporters of the Ministry.

3. — Rumania : State Railways.

The operation and administration of the Rumanian Railways has been placed under a public and commercial administration under the control of the Ministry of Public Works and Communications.

The administrative council and the general management are the chief managing and administrative organisations in this administration.

The administrative council consists of a general manager and 9 other mem-

bers appointed by the Ministry of Public Works and Communications from distinguished representatives of industry, commerce, agriculture, and finance, and finally a delegate of the Ministry of War. The administrative council deals with the whole management of the autonomous Rumanian Railway administration other than the approval of the annual budget which is submitted to the whole of the Chamber of Deputies, the solution of questions in connection with money loans, the international rates and agreements, new lines, etc., all questions which have to be submitted to the Government for approval.

The work of the administrative council is facilitated by a managing committee, a delegation of the council itself, composed of the general manager and two members elected by the council, which has authority to decide certain questions itself and to which belongs the duty of examining all problems before these are put before the council, and in addition, by a finance committee, similarly constituted to the managing committee, which is allowed to deal with financial matters and the approval of payments.

The Government is represented at the meetings of the administrative council by a commissioner whose duty it is to supervise all acts of the administration whilst acting in a consultative capacity.

The general management at the head of which is the general manager assisted by two assistant general managers has under its control eleven central managements and two central departments which, in order that all work may be dealt with more easily, are grouped under three higher managements run by three assistant general managers.

At the general headquarters there is a secretariat service of the administrative council, and also a higher control service, and an inspectorate of profes-

sional instruction, all of which work as headquarters services.

The railway is divided from the administrative point of view of the operating into ten areas, known as operating inspectorates, each with its traffic, running, and permanent way maintenance inspectorates and a financial section.

As control organisation in order to harmonise all the outside services these operating inspectorates are grouped under 4 operating managements having at their head a manager assisted by a representative from each branch of the operating service.

In addition to the setting up of these control organisations which cover at the same time the coordination between the various branches of the operating services subordinated to them, the Rumanian Administration has considered it its duty to organise periodically conferences to which are called the heads of all the outside operating services, as well as the managers of the services at each headquarters management. With the object of assuring the liaison between and the unified working of the railway services, the general management prints and issues « The Official Rumanian Railway Sheet », a weekly notice reproducing all the orders and instructions issued by the headquarters administration.

In its general lines, the budget of receipts is prepared by taking into consideration the sums paid in during the last five years, the variations in the traffic of the last year, new agreements affecting the traffic and the general situation. The budget of receipts is divided into two main sections:

1. Passenger, luggage, goods, etc., receipts;
2. Various (leased vehicles, receipts from auxiliary undertakings, etc.) receipts.

The expenditure budget is divided under 13 heads or classes of expendi-

ture (these expenditures are administrative and affect the different operating services, including the auxiliary services, etc.). The expenditure budget is drawn up according to the actual requirements.

The control of the receipts during the working year is based on the traffic returns which after the accounts have been completed are sent by the financial sections to the receipts control service of the financial management where the receipts of the stations are checked by drawing up each month a table of provisional receipts based on the preceding month.

The other classes of receipts (miscellaneous receipts) are dealt with by a section of the accounts service of the financial department.

In addition to this headquarters financial control under the financial management there is a control service for dealing with the cash offices. This service has to make periodic or surprise checks of all the money taken (tickets, goods, luggage, etc.) at the stations, that is to say has an executive function whilst working very closely with the receipts auditing service.

A third headquarters control is that exercised by the inspectors of the financial management whose wider activities involve all manner of investigations, checks, and enquiries in connection with money or materials.

The financial divisions, the executive organisations of the financial department, in turn have at their disposal a certain number of controllers who have to carry out inspections, both surprise and periodical, the instruction of the staff also falling on them.

The control of expenditure as carried out at the present time is by seeing that all formalities laid down as regards reception and invoicing have been complied with within the lines of the budget and on the basis of the authorisa-

tions given by the competent organisations.

Payment vouchers are checked by the financial divisions and by the accounts service of the financial management of the headquarters administration.

The ultimate check of the expenditures is carried out by the financial committee (general manager and 2 delegates of the administrative council) which examines and approves the more important expenditures relating to the railway, at the same time taking steps to provide for the payments as they fall due after taking into account the funds available.

4. — Switzerland : Federal Railways.

The Swiss Railways are managed and worked by a federal administration, as full independence as possible being left to the different departments.

The political authorities, that is the Federal Assembly and the Council exercise the right of supreme control over the undertaking. The Federal Assembly legislates on general principles as regards rates and pay, approves the budget and authorises the Federal Council to make loans; the Council issues instructions considered necessary to the railways, appoints the president and the members of the administrative council and those of the general management, approves all major works, timetables, the statutes governing the insurance of the staff, etc.

The administration properly speaking consists of : the administrative council, the area councils and the management.

The administrative council has the first word in all important matters which are reserved to the Federal Assembly or the Federal Council.

The area councils do not make decisions but discuss important matters and can express their views thereon and put forward suggestions.

The management of the undertaking consists of a general management consisting of the president and two general managers who, under reserve of the subjects attributed to the administrative council, exercise the supreme management of the business, deciding the important questions, those of lesser importance being settled inside the respective departments, three in number.

The railway system is divided into three areas, the management of which looks after the following services: management of the property of the railway, accountancy and funds, maintenance and supervision of the track, stations and trains, traction, warehouses and cartage services. Each area has a manager in charge and each division, a divisional superintendent who corresponds directly with the heads of the departments at the general management.

The collaboration between the various services has been improved by reducing the number of divisions, the progress above all consisting in the fact that direct correspondence between the headquarters and divisions has been instituted and that a telephone system, connecting up all services has been installed.

The annual budget of receipts is based on the first six months of the actual year's working, the total for these six months being increased by the average of the second half of the three preceding years. Economic reasons which might affect the receipts are also taken into account.

The budget of expenditure is drawn up by the general management, in agreement with the area managements according to actual needs, the principal items concerning the expenditure for each service, in addition provision being made for a special account in which figure mainly the amounts set aside by the administration in favour of the insurance of the staff.

The « auxiliary services » such as the

stores, workshops, and electric power stations, have a separate budget and system of accounts. The return of traffic receipts is supplied by the stations every 3 months as far as the Swiss passenger, luggage, and express parcels service are concerned, and monthly as regards passenger, luggage and parcels traffic for abroad and cattle and goods traffic.

As regards passenger traffic the control verifies by means of a calculating machine the total passenger receipts calculated from the number of tickets sold. In the case of luggage and express parcels, the returns supplied by the stations are checked against the numbers on the booking-in sheets which ought to follow one another exactly; usually this check is only carried out once a year, and is applied to one month's working only.

In the case of cattle (both internal and through traffic) the waybills are used to check up the carriage charges due and a comparison is obtained by adding them up mechanically and checking them against the returns of arrivals.

In the case of goods (small consignments sent carriage paid over the system itself) the control is in regard to the accuracy of the total amount.

The control of small consignments sent carriage forward over foreign lines is effected by means of punched cards (by means of punching, tabulating and sorting machines) the tabulations obtained being compared with the station returns of despatches.

In the case of consignments sent away in accordance with the internal traffic outwards book, the charges paid, the repayments on delivery made, and the charges due are compared station by station by comparison between the books of the sending stations and those of the receiving stations.

In through Swiss traffic, this work is done by machines.

In the international goods traffic, waybills are used and the totals given thereon are compared with the returns of arrivals and made to agree with the returns of despatches.

5. — Poland : State Railways.

The system is territorially divided up into nine area managements, each having on the average 2 000 km. (1 240 miles) of lines. The area managements are under the Ministry of Communications which takes the place of a central administration.

The area management is under a chief manager who controls the different services.

In order to ensure cooperation between the services, conferences attended by the heads of the services and the divisional superintendents have been instituted.

The budget of receipts is prepared on the basis of the actual receipts of the previous year's working whilst giving weight to considerations having to do with the financial condition of the country.

The budget of expenditure is prepared according to requirements. The programme of expenditure put forward by the area managements has to be fully justified and in addition has to be approved by the Ministry of Communications.

The control of receipts is carried out by a special service. The Ministry of Communications in its capacity of General management of the railway system alone has authority to dispose of these receipts.

The current expenditure is controlled by allocating to the different services monthly sums according to a programme fixed beforehand within the limits of the budget.

6. — Bulgaria : State Railways and Harbours.

The central organisation of the Railways and Harbours is the general man-

agement at the head of which is placed a general manager who, assisted by the managers of the departments, coordinates the work. The headquarters administration is divided into managements subdivided in their turn into various departments.

The different services are connected together by the permanent council which under the presidency of the general manager discusses all important questions concerning the improvement and the standardisation of the system and the traffic. Questions of national interest are discussed by a superior consultative council which meets under the presidency of the Minister of Railways and Harbours.

The various executive services are directly under the respective headquarters of the central administration.

The budgets of receipts and expenditures are got out on the basis of a proposal drawn up by the general management. This proposal has to be approved by the Sobranje and all modifications made in distributing the credits must be approved by the Minister of Railways.

The control of the receipts is based on the following :

1. A central control carried out by a special service at the general management;

2. For the internal service the check is made monthly; for the international passenger service it is carried out quarterly;

3. The checking carried out is based on the waybills and the monthly statements from the stations;

4. The control is generally carried out during working hours, the system of agreeing the accounts not being allowed up to the present;

5. All sums not paid in are charged against the staff responsible for seeing they were collected.

7. — Yugoslavia : State Railways.

The Yugoslav system is controlled by the Ministry of Communications. The general management of the railways which forms part of the Ministry is the headquarters organisation which directs the administration and the operation of the system by means of a number of departments.

Under the general management there are 5 area managers, each having under him 4 divisions by which the executive services are controlled.

The liaison between these different services is provided by the permanent and constant collaboration between these services.

The liaison between the various subdivisions of the services as well as between the headquarters services, the area services, and the various working centres of the line has been improved by installing new telephone and telegraph lines; by the simplification and acceleration of the administrative work and by closer control.

8. — Sweden : Grängesberg-Oxelösund Railways.

An administrative office for the three groups of systems has been formed, and in addition an area office.

No budget of receipts has been prepared.

The budget of expenditure is got out on the 1 December of each year, the real expenditure for the months January to September of the same year being used as the basis. New works and purchases of rolling stock are provided in the budget separately.

The control of the receipts and expenditure is carried out by monthly reports from the different departments. The check of the accounts and the inventory of the money in hand are made once a month at least.

QUESTION No. 3.

Describe the general organisation of the operating department. Indicate the progress made as regards liaison between the various subdivisions of this service as well as between the headquarters services, the area services and the various works of the line.

Replies.

1. — Germany : German State Railway Company.

The operating department deals with all questions concerning the formation and the working of the trains over the line and in the stations as well as with the working time tables.

The headquarters authority which is a department of the « Hauptverwaltung » issues service instructions according to which the area managements (Reichsbahndirektionen) carry out their functions through from three to twenty-four operating divisions (according to the area covered by each area management). The operating duties properly speaking are carried out by the stations.

To agree matters of interest or discuss questions common to several area managements there are also three chief operating services (Oberbetriebsleitungen), directly under the Hauptverwaltung, their principal role being to rationalise the traffic and the operating in the areas in question.

The divisions have under them for the purpose of looking after the stations and the track, district maintenance services. In the case of large works temporary construction services are formed for the purpose.

On the Reichsbahn the operating Department (up to the headquarters administration) is completely separated from the traffic services, this latter having to prepare the rates and to take all steps needed to get a better use of the passenger and goods trains.

For supervising the different local services, there are at each area management a number of traffic inspectors, corresponding to the operating inspectors of the same management. In order to lay down the relations or the liaison between the different departments, instructions (Anweisungen) have been drawn up and distributed to the staff in which the rôle assigned to each department is given.

The results are seen in the uniform way in which the work is carried out throughout the railway system.

2. — Czechoslovakia : State Railways.

The operating department is divided into two services : the traffic and the commercial, the liaison between them being either verbal or by writing.

The work of these two services is carried out :

a) in the small stations by the same men;

b) in the large stations by different employees all under the station master;

c) at the headquarters management of the railway by 2 distinct services, and likewise;

d) at the Ministry of Railways where there is a traffic department and a commercial department.

The traffic department and the rolling stock department have close relations in the stations where the stock is disposed of and where the trains are formed, these stations having special staff who look after the formation and the working away of the trains.

With the other services, especially the permanent way maintenance service in the stations, at the management of the railways and at the Ministry, the respective traffic services deal with common matters either verbally or in writing.

The direct relations between the stations and the management are assured by a number of controllers who have

either limited or complete authority in all that concerns the executive services.

Operating administrations have been set up for the whole of the services (maintenance, operating, etc.) of some light railways, which administrations, under the headquarters managements, have brought together the whole working of the undertaking under one control.

The good results obtained by the organisation of the operating department may be ascribed to the existence of direct links between all the services.

3. — Rumania : Rumanian State Railways.

The operating department is conducted and supervised by two headquarters managements : 1) traffic, and 2) commercial.

1. Traffic, which deals with all questions relating to the working of trains, the selection and distribution of wagons to meet requirements, supervises by its outdoors department, that is to say the traffic divisions, the working of all the stations of the system, issuing the orders and instructions required for the proper running of the department. One of the most important questions which can only be settled at headquarters is the preparation of the train workings for the whole system.

2. Commercial. — The management is divided into 3 departments : administrative and staff; local and international rates; and third, claims, commercial matters, enquiries, customs offices. It has connections with the other services through the train working inspectorates (which combine the duties of the traffic and commercial departments) through which it supervises the stations where the requirements of the two services are carried out by the same staff.

These outdoor services, train working inspectorates and stations have a certain amount of authority in traffic and commercial matters : beyond the limit

allowed these matters have to be referred to the headquarters managements (traffic and commercial) to be dealt with.

The questions which are outside the competence of these traffic and commercial managers are sent for approval to the general management.

The limits of authority allowed each service are fixed by departmental orders based on the operating regulations of the Rumanian Railways.

As regards questions which concern several services at the same time, these are considered and settled by committees formed for the purpose by delegates from these services.

4. — Switzerland : Federal Railways.

The general organisation of the operating department is as follows :

A. General management.

1. *Works and operating department*, managed by a general manager. To this department are attached 4 divisions, one of which deals with stations and train working, this being the operating division.

2. *Station and train division*. — The head of this division is the principal operating superintendent to whom are attached an assistant, heads of sections, operating inspectors, the head of the central wagon control, which is the chief distributor of rolling stock and the office staff.

This organisation, which has a special commission to consider, the improvements to be introduced, has been found to be a rational one, the liaison between the different offices assuring the proper working of the service.

The chief operating superintendent manages the business within the limits of the organisation and of the budget, having the right at all times to require the divisions to send him full information on all matters with which they are authorised to deal.

B. Area managements.

1. At the head of each area there is a manager, under whom are three divisions, namely : administrative, works and traffic.

2. The traffic division has the following subdivisions :

- a) stations and trains;
- b) traction.

At the head of this division is the operating superintendent. In the case of the station and train services he is assisted by an assistant, section heads, inspectors and the necessary administrative staff. (For details see Regulations No. 1, XVII and No. 2, VI).

In comparison with the old organisation the authority of the outdoor services has been considerably increased and this has had the effect of simplifying the relations between the different services.

5. — Poland : State Railways.

Each area manager has its own operating service with various divisions. Under the operating department at the area headquarters are the operating sections which by means of their divisions and subdivisions control the executive operating service and the station workings.

The progress made in the organisation and working of the operation department is considerable but the work started with these objects in view is not yet finished.

6. — Bulgaria : State Railways and Harbours.

The operating management, covered by a manager, consists of the following services :

1. The secretariat, general service, dealing with the administration of the railway in general;

2. The « train working » section which controls the service by means of

a central administration with various sections and several area inspectors under whom are the control, station, and traffic staff;

3. The « commercial » section with its own headquarters administration and subordinate offices; rates offices; claims office; statistical office.

4. The « track maintenance » section controls the service by a headquarters administration and 12 sections;

5. The « traction » section with a headquarters administration which controls the depots and workshops.

6. The « rolling stock » section with its headquarters offices under which come the stores and laboratories;

7. The « budget control » section with headquarters administration, controllers and assistants;

8. The « general accountancy » section with its headquarters, inspectors and accountant;

9. The « receipts control » section with a similar organisation; and finally :

10. The « health » section with its headquarters administration, inspecting doctors, area doctors, section doctors, chemists and the necessary staff.

7. — Yugoslavia : State Railways.

The operating service of the general management consists of two departments :

- a) train movement and traffic;
- b) commercial.

8. — Sweden.

No reply to this question.

QUESTION No. 4. — *Describe the general organisation of the rolling stock and traction department.*

Describe the progress achieved in the liaison between the various subdivisions of this service as well as between the

headquarters services, area services and the different works of the line.

Replies.

1. — Germany : German State Railway Company.

The general organisation of the technical locomotive service (Maschinen-technischer Dienst) consists of, starting from the central administration, two services :

- 1. Workshops;
- 2. Traction and rolling stock.

The organisation of the traction and rolling stock service which deals with the utilisation of locomotives and wagons, electric power stations, gas works, etc., is much the same as that of the operating or traffic services (controls, depots, etc.).

The shop service differs in its organisation from the other services.

All the area managements do not control the workshops in their areas, only some of them carry out this work and in this event control the workshops in several neighbouring area managements.

There is a special workshops service at each of these area managements to cover this work.

2. — Czechoslovakia : State Railways.

At large marshalling stations, at important industrial centres as at transit stations, the lubrication of the vehicles and the regular examination of the trains after running 250 km. (155 miles) in the case of stopping trains, and 200 km. (124 miles) for goods trains, are covered by examiners and the stations in question are known as examination stations. On local railways there are no permanent carriage department examiners, this work being done by the drivers and firemen.

These executive organisations are subjected to the control of the locomotive shed administrations and to the

technical rolling stock department, a self-contained unit in the rolling stock and workshops section of the management.

As regards the traction service, the system is divided into 44 districts. In 36 of these districts the service is covered by the principal section of the traction service which is the « locomotive depot administration » under which is the traction and also partly the workshops dealing with the running repairs of the locomotives and the other vehicles. The depot administrations control in their districts the outlying sheds attached to the depots, the smaller depots, the rolling stock sidings, the water columns and the train examining points.

In the other 8 districts, which are only small and deal with light railways, the traction service is covered by the « operating administrations » mentioned above.

The locomotive depot also supervises the work done in the neighbouring districts by its own staff who have to go into these districts.

Under the former administration the traction service was formed of a large number of small shed administrations. Since the revolution, the traction service has been concentrated into a small number of offices with a larger area to look after, a method which has shown considerable operating economies.

The selection of engines, the handling of breakdowns, and the utilisation of the locomotives over a wider area have been greatly facilitated; the locomotives can be repaired more conveniently and more rapidly, the organisation of the repair work can be regulated more readily; machines can be put down so as to save labour, and as regards the staff, the accountancy administrative and supervisory work can be centralised, and the number of employees reduced. Obviously the importance of the duties to be fulfilled, the work to be done and likewise the responsibility

of the men in charge of the locomotive sheds and the sections has grown. The organisation so developed meets the needs so that alterations of principle thereto are not proposed.

3. — Rumania : State Railways.

The responsibilities of the traction and rolling stock department of the Rumanian Railways are divided between two headquarters managements :

1. Workshops and rolling stock;
2. Traction.

1. The workshops and rolling stock management is the headquarters unit which deals with the general administration of the 10 main workshops at which stock is repaired (covering the areas of the railway system which do not correspond with the operating divisions and which have under them a number of small shops as well as the wagon repairs) as with all questions of improvement in working methods (manufacture and repair) in the shops, the organisation of the work and the standardisation of existing types of vehicles, etc., in brief with everything which may interest or improve in any way the upkeep, repair and renewal work for the whole of the services under its control.

The relations between the workshops and rolling stock department and the other departments of the railway are quite close, especially in the case of the traffic when dealing with the over-haul of wagons at the most important stations (owing to the many lines to being of some size, by its principal sections, through shunting and marshalling trains etc.), with the traction for questions which relate to the heavy repairs of locomotives (the liaison is made either by headquarters between the two managements or between the traction inspectorates and the main workshop in service).

2. The traction management, the

headquarters which with its five headquarters services supervises and issues all general service instructions to the 10 traction divisions (outdoors service) which in turn direct the service, by 4 special offices: *a)* staff; *b)* installations upkeep of sheds and water supplies; *c)* working and maintenance of the locomotives; and *d)* accounts and stores) administers, controls, arranges, or suggests to the headquarters management all improvements of all kinds affecting the running of the main and ordinary depots the sheds under the main depots, and the water columns in their district.

4. — Switzerland : Federal Railways.

The traction and workshops department is included in the works and operating departments. It is placed under the orders of the chief locomotive engineer.

Each of the 3 area managements has its own traction service which looks after the locomotive sheds, the workshops and the rolling stock service and which receives its technical instructions from the headquarters of the service at the general management.

The traction and workshop headquarters division manages the workshops service and the six main workshops for repairing rolling stock.

Before 1924 the main shops were managed by the area managements. The present grouping together of these services forms a great progress as regards the rationalisation of the work. The introduction of direct relations between the headquarters administration and the traction service in technical matters in the areas must also be considered an improvement.

5. — Poland : State Railways.

The mechanical department (traction) of the area managements includes the locomotive and rolling stock divisions and controls the traction sections

which through their offices and staff direct the locomotive depots and shops attached thereto.

The progress made in the organisation and the functioning of the traction service is important, but the work in hand in this direction is still incomplete.

6. — Bulgaria : State Railways and Harbours.

The traction service is represented by the traction section at the operating headquarters which directly controls all the main workshops including the locomotive sheds and the secondary shops, these sheds covering 5 traction districts.

The traction section is subdivided into a certain number of offices namely :

1. Administrative office dealing with staff questions;

2. technical office which draws up specifications for materials, locomotives and rolling stock;

3. shop office which directs the repairs in all the shops;

4. traction office which deals with running repairs to locomotives and wagons and with the movement of staff to meet service needs;

5. wagon office which deals with questions relating to the circulation of wagons on foreign systems;

6. premium office which calculates the economy to be obtained by the locomotive men as regards fuel and lubricants.

The subdivision of the traction service into main and secondary workshops attached to the locomotive depots was done to rationalise the maintenance of the tractors and rolling stock.

7. — Yugoslavia : State Railways.

The general organisation of the traction and rolling stock service consists of :

- a)* a department at the general management;

b) departments at the area managements;

c) works on the line (locomotive sheds and shops).

8. — Sweden.

No reply.

QUESTION No. 5. — *Describe the general organisation of the permanent way and works department.*

Replies.

1. — Germany: German State Railway Company.

The works service (Baudienst) is everywhere in close relationship with the operating service (Betriebsdienst).

The headquarters administration, the operating service, includes a subsection for the works service. At some of the more important area managements the works service is separate from the operating service and at the operating inspectorates the operating and works services are without exception united.

2. — Czechoslovakia: State Railways.

The supervision of the line is covered by supervisors and controllers who when walking the line are required to correct anything that could interfere with its complete use, as also are the working gangs who carry out the normal repair work to ensure the line being properly maintained. These gangs work to a carefully drawn up programme under the supervision of a ganger and under the control of a permanent way supervisor. The latter assists in drawing up the report on the work of the ganger and calculates the unit of output of each day's work.

The monthly and annual results are then calculated and compared by the next higher department responsible for the maintenance of the track, which also

gets out in collaboration with the chief inspector the programme of work. The liaison between the managements as well as the control of the different sections of permanent way maintenance are covered by the works department at the managements. The works section at the Ministry of Railways exercises the supreme control and formulates its conclusions in the light of comparative results from all the managements.

3. — Rumania: State Railways.

In principle the organisation of this service follows the lines of the other operating services, that is:

The headquarters management is under the maintenance, works, bridges, and new works department, divided into several headquarters services.

4. — Switzerland: Federal Railways.

The permanent way construction and maintenance division, a section of the works and operating department of the general management is controlled by a chief engineer assisted by an assistant, section heads and the necessary technical and administrative staff. This division is responsible for the execution of all works, just as it looks after the whole of the supervision and upkeep of the track carried out by the works division of the areas. Any other information needed is to be found in Regulation No. 1 dealing with the organisation of the general management, its departments and its divisions.

5. — Poland: State Railways.

The supreme management of matters affecting the permanent way and works service lies in the way and works department of the Ministry of Railways. The area managements each have a permanent way and works service. These services, divided into several branches, direct and supervise the works by means of their respective sections

[length of main lines : 200-400 km. (124-248 miles)], and districts. The progress in the organisation and functioning of the way and works department is considerable but the work started in this direction is not yet complete.

6. — Bulgaria : State Railways and Harbours.

The way and works service divided up into a number of offices constitutes a special service of the operating management at the general management. The same service includes in addition to the headquarters service the outdoors department formed by 12 track and works maintenance sections and the workshop for dealing with the repairs and the building of different structures, signals, points, and crossings, etc. The track sections are directly responsible to headquarters.

7. — Yugoslavia : State Railways.

The general organisation of the way and works service is the following :

- a) general management;
- b) area managements;
- c) the permanent way installations, i.e. the maintenance sections of the track and buildings.

8. — Sweden.

No reply to this question.

QUESTION No. 6. — *Have you any organisation common to several services?*

What is the duty of each of these organisations?

Have the results obtained come up to expectations?

Replies.

1. — Germany : German State Railway Company.

In addition to the central administration and the area managements under which all the services are united there are such organisations in the higher

operating managements (Oberbetriebsleitungen), the operating and train movement services of which are common in the operating and commercial inspectorates as well as in the stations (operation and movement), with the exception, however, of the important stations where these two services are separated.

The experience obtained with these united services has been good.

2. — Czechoslovakia : State Railways.

There are no organisations common to several services.

3. — Rumania : State Railways.

Outside the operating managements which function as organisations to control and harmonise the outdoors operating services, the autonomous Rumanian Railway Administration has organised a special service for the supply and administration of all stores, the central stores service represented by the stores management under which come all main and local stores, 12 fuel inspection services as well as the sleeper creosoting works, the brick works, furniture works, and a printing works.

Besides these services which are joint solely as regards the issue and supply of materials, the only service the organisation of which is common to other services is the train working service, the outdoors sections of which also carry out or decide questions falling within the competency of other services (commercial and financial).

The results obtained by setting up these joint organisations, the first two of which, the stores and the operating, are under this form of recent creation, are satisfactory.

4. — Switzerland : Federal Railways.

At the general management and at each area there are a registry and a

secretariat. In addition at the general management there is a library which is available to all employees of the railway.

There are also : A stationary section which purchases all paper needed and all forms for the whole railway;

Translation services at the general management and at the areas so that all important communications, proceedings, etc. can be reproduced in each of the national languages (German, French and Italian).

A press service for information on all subjects for issue to the papers.

All these services, to the extent that they do not come under the areas specially, are attached to the general secretariat.

A service which is of great importance is the stores which is responsible for the purchase, inspection, keeping, issue and accountancy of the materials required by the operating services (with the exception of stationary).

As a rule the results obtained have been satisfactory. The centralisation of the organisations in question has made it possible to effect considerable economies, speed up business and ensure the unification of the methods used.

5. — Poland : State Railways.

There are no organisations common to several departments, but there are a number common to all general headquarters, namely :

1. central accounts office for the international traffic;

2. Central traffic statistics office;

3. Central office for dealing with wagons in international traffic;

4. Coal office which supplies coal for the whole system;

5. Central enquiry office which deals with all business relating to want of load and of loads without documents; and

6. Projects and designs office dealing with the large works.

The results obtained have proved satisfactory.

6. — Bulgaria : State Railways and Harbours.

There are no organisations common to a number of services.

7. — Yugoslavia : State Railways.

The organisation common to the executive services is the area management which makes possible and supervises the collaboration between the various services.

8. — Sweden : Grängesberg-Oxelösund Railways.

The administrative office is common to all three services (operation, rolling stock and permanent way).

The head of this office, the managing director, is also over the managers of the three services mentioned.

CHAPTER II.

Improvements introduced into working methods, installations and equipment. (Scientific organisation of the work.)

QUESTION No. 7. — *What measures have been taken to facilitate the administrative work ?*

How is the correspondence dealt with and circulated and the papers classified ?

How are the statistics prepared ?

How are they linked up with the accounts ?

How is the pay of the staff made out ?

Replies.

1. — Germany : German State Railway Company.

By the adoption of modern methods the administrative work has been appreciably lightened.

The introduction of card indexes in place of the usual registers and the classification of notes in special files have meant a real progress in the preservation of the documents through the simplification which resulted therefrom.

As regards the circulation, the classification and the preservation of the papers, a single instruction is followed throughout the Reichsbahn.

As soon as received, the papers are stamped and distributed to the different offices, to be dealt with. They are put in special folders with their destination clearly marked thereon.

After being dealt with the important papers are preserved in the files, the others being destroyed every two years according to the regulations.

The statistics are drawn up conjointly and are based on the statements of accounts or on special data in relation to certain given matters. These data are generally supplied by the area managements within the limits of the sections they control, the concentration for the whole of the services of the Reichsbahn being effected subsequently by a central office. The general statistics dealing with the receipts and outgoings are the only ones built up on figures passed in the cash books and on the documents supplied by the accountants.

The staff of the Reichsbahn as regards their legal rights are divided up into three principal categories :

a) Officials whose legal rights are defined by law, or based on the legal rights resulting from the powers conferred on them by the Reichsbahn. Officials alone are attached to all the administrative services, operating, workshops, maintenance and supervision of the track services, etc., and in general to all the supervisory positions.

In addition to these classes of officials, for the highest posts there are : a general manager, his deputy, the members of the management committee (Vor-

stand), the departmental managers, and the elected delegates of the headquarters administration; in addition there are, at the area managements, presidents, vice-presidents, managers of departments, etc., in all about three hundred officials having managerial duties, whose salary is fixed by the administrative council.

The salary of the other employees is fixed by the Reichsbahn in conformity with the prescriptions of the law on the organisation of the Reichsbahn, any departure from the requirements of this law having to receive the approval of the Government.

b) The « Angestellte », employees engaged on works directly undertaken by the Company, about 400 at the present time, including technical employees of different kinds, doctors, etc., are engaged under common law contracts. Their salary is like that of the clerical employees and their conditions of work are laid down in an agreement relating to rates which the Reichsbahn concluded with the respective professional associations on behalf of its employees so employed; and finally :

c) The workmen whose working conditions and pay are laid down in the wages agreements.

2. — Czechoslovakia : State Railways.

In order to facilitate the administrative work all fabrics used in the uniforms of the staff have been standardised, their purchase being centralised in one of the management offices of the State Railways, and this in practice has meant a great technical and financial benefit.

Five years ago the method of enclosing service documents in envelopes was given up, as it was costly. Today the papers are put into bags and these are distributed to the respective services. By this method excellent results have been obtained both as regards savings

as from a moral point of view through the confidence thereby exhibited in the men. For sorting the letters, at each management, a central registry has been set up which has made it possible to deal with them in a standard manner and to draw up synoptic tables on all the different questions affecting the various branches of the services.

The rationalisation practised in all the work of the railway has required the development of the statistical service, and this has been obtained by replacing manual labour by machines. This mechanisation has been carried out gradually. The details and the charges for wagon hire are dealt with by Powers punching, sorting and tabulating machines. The statistics of the goods traffic, those dealing with the employees and questions affecting the employees, as well as the statistics of the results of the train workings, the proper utilisation of the train staff and of the capacity of the trains, the movements of trains and vehicles, etc., are completed by means of Hollerith machines.

The returns of a collective nature are sent by the outside services to the area management where they are classified.

The results obtained are published either as extracts or under the form of detailed reports. They are most satisfactory as regards rapidity, detailed information, and saving in staff and material, when compared with the manual method.

Next year the mechanised statistics are to be extended to the calculation of the work done by the locomotives, the consumption of fuel, lubricants, and lighting materials, as well as to the consumption of other carburants.

The connection between the mechanised statistics and the accountancy is slight. The only statistics based on data supplied by the accountants are those dealing with accounts for wagon hire.

The method of dealing with the pay-

ment of salaries to the staff differs according as it is a question of :

a) permanent staff and temporary staff, and

b) staff engaged on contract (employees under contract, auxiliary workmen, etc.).

The scale of pay is based on the division of the employees into categories, according to the classification of duties, on the pay sheets prepared in different ways for the standard groups of employees :

1. Officials;
2. Employees on fixed salaries;
3. Junior officials and staff; and
4. Auxiliary staff.

1) The officials are divided into :

- a) those with higher educational qualifications;
- b) those who have completed their secondary courses of study.

2) Employees on fixed salary, a category in which are included for example : master builders, machine shop foremen, train controllers, etc.

3) The junior officials and staff cover the less important executive duties (chargemen in the workshops, drivers, head-guards, conductors, permanent way inspectors, pointsmen, foremen shunters, etc.).

4) Auxiliary staff divided into craftsmen or unskilled labourers.

The pay of the men in grades 1 to 3 is completed by a supplement varying according to their position in order to make up for any increase in cost of local lodging conditions, and by an allowance to meet family charges paid to married employees, but limited to a minimum of two children. A recent law has resulted in the institution of a Christmas gratuity amounting to 70 % of the monthly pay.

The men engaged by contract are not included in the booked establishment of the staff; they complete this establishment over and above the usual strength should need arise.

3. — Rumania : State Railways.

Among the measures considered in view of the simplification of the administrative work may be mentioned the following :

a) use of a standard form for staff changes;

b) various printed documents and forms;

c) card registers for the staff according to categories and finally;

d) for the individual instruction (orders, regulations, etc.) of all the staff, the institution of an official publicity bulletin, « The Official News Sheet of the Rumanian Railways ».

A single registry is provided for all managements and headquarters services. This registry approves and distributes all the individual demands as well as all the more important service reports.

To facilitate dealing with the reports, they are placed in holders which show on the front the main points of the information they contain and their destination. In addition these main points of the reports are collected together in summaries which are used to form other registers in which the names of the persons or authorities from whom the request emanated are entered in a given order (alphabetically).

As regards the circulation of the papers as between the headquarters services all the papers have to be sent as the whole of the dossier has to be consulted.

When a report has to be sent to the different services, the report may be taken from its covering holder, or a copy of the original report may be sent.

In the case of correspondence be-

tween other authorities, or with individuals, the suggested reply will be written on the back of the original report or on a paper attached to it : the reply will be sent by separate letter.

The reports when finally dealt with are filed away in the records.

The daily questions of minor importance are dealt with in separate reports which are given a reference number, followed by the serial number of the report.

This registration system of the headquarters managements is also applied to the outdoors services, as well as to each area management considered separately.

The many advantages of the above system have been demonstrated in practice.

The statistics relating to the work of each branch of the operating services are prepared on information supplied by the accountancy department based on information collected by each actual operating organisation; this information is submitted to the next higher organisation for investigation. The results are entered on special cards for each group of questions separately investigated. These cards are subsequently sent to the managements where they are brought together and completed by mechanical means, the final results being sent to the central statistics office which prepares from them the respective tables, diagrams and graphs.

As regards outgoings, the accountancy service at the financial management supplies the statistics office with the monthly particulars from which the latter extracts the necessary figures.

The Rumanian railway staff is divided in accordance with the present law into three main categories :

1. Officials divided into 27 classes;
2. Staff divided into 8 classes;
3. Workmen; and
4. Auxiliary staff, engaged as needed

and for as long as their services are required.

1. As regards the officials, their duties are laid down in a table of employments, giving the division of duties by categories and the subdivision of these latter in classes. They are members of the « General pension fund » and are paid monthly.

2 and 3. In the case of the staff and workmen, their duties are also laid down by categories and classes, the staff being paid monthly, and the workmen by the hour or the piece. They belong to the « insurance fund ».

4. The temporary staff is paid daily as agreed; they are considered as members of the « insurance fund » although they are engaged and discharged as the work requires.

The monthly pay of the officials and staff is fixed and adjusted from the points of view of increases or retentions by the general and special prescriptions of the regulations and by-laws.

The work done by the workmen in the main shops is paid for according to an agreement; in the event of this method being temporary inapplicable, the workmen are paid by the hourly rates plus a 20 % supplement (known as « agreement compensation »).

4. — Switzerland : Federal Railways.

The methods adopted during the last 10 years to simplify the administrative work, although many, are all based on the following : organisation according to the principles of rationalisation, increase in the authority of the outdoor or subordinate branches of the services, direct communication between the divisions of the general management on the one hand and communication between these latter and the area divisions on the other, replacing as far as possible written correspondence by telephone messages, etc.

Excepting registered letters and value letters which are handed in to the principal cash office against a receipt, all the correspondence addressed to the general management is concentrated in the registry offices of the general secretariat which distributes the papers to the different services concerned. Only correspondence of permanent value or of importance is entered in the register. Letters addressed to the divisions are sent to them direct.

The papers are sent to the services in open card or paper covers.

The letters sent out by the general management by post are first of all entered in the registry, then handed to the chancery, where they are stamped and forwarded to destination.

Papers from the general management and the divisions sent by railway, the same as correspondence between area managements and the outdoors services, are enclosed in bags and sent by certain stated trains.

The papers relating to matters disposed of are sent to the records office where they are filed vertically in moveable holders in accordance with the method of classification of the records in use.

The passenger statistics are got out from the returns compiled by the stations and checked by the finance control. The results are worked up quarterly and deal with the number of passengers and the receipts. The number of passengers and passenger-kilometres is calculated as exactly as possible, but when accurate data is lacking the figure obtained is based on the averages.

The statistics relative to luggage and cattle are based on the station returns, the weight of the luggage being given exactly, the weight of the cattle carried being calculated on the average weight of each animal.

As regards statistics of goods traffic both internal and through Swiss traffic (traffic for private Swiss railways

or the reverse) and for through traffic with abroad, the quantities conveyed are calculated from the particulars given by the stations.

As regards international transit traffic, the calculation is made on the basis of the accounts established by the foreign railways and checked by the Swiss traffic control.

The statistics of the work done by the operating department have been got out since 1925 by means of perforated cards (Powers system) the method used being the subject of a very detailed study in the *Bulletin of the International Railway Congress Association* (August 1928).

The statistics of the work done by the locomotives, trains, and wagons are based on the guard's statements. In the case of the locomotives the returns are made out each month for each locomotive and include the locomotive-kilometres and the gross train-kilometres.

The train returns are got out quarterly by lines and stations, separately for each category of train.

The system of perforated cards is also used when calculating the supplementary allowances granted to the locomotive men.

There is no liaison between the statistical and general accountancy services as the particulars required by the statistical service are sent in directly by the stations or the traffic control. The pay of officials, staff and workmen of the railway is laid down in the federal law and in ordinances. The officials are grouped into different classes of pay as are the staff, the status of staff being given to employees who are not officials and do not work by the day or on piece work. The workmen are paid by the day or by the hour. Besides the regular pay there are additional allowances of a social character (lodgings allowance, children allowances), the lower grades also receiving free uniform plus night allowances, and kilometrage allowances (for train staff), etc.

Salaries are paid monthly according to the pay lists, the night allowances and extra allowances being also paid monthly. Annual pay lists introduced in 1926 are drawn up as well as cards for the monthly contributions of the employees under each name.

The shopmen who come under the law on working hours are paid monthly on the 7th day of the following month; between each pay on the 21st of each month they receive an advance of pay.

The shopmen coming under the law relative to manufacturing establishments are paid three times a month.

The workmen like the officials are paid on the basis of the monthly lists and returns.

5. — Poland : State Railways.

The organisation section at the Ministry of Communications is responsible for examining the administrative work and for investigating the best methods for improving it.

When the mail is received at the secretariat of the area managements, each letter is entered in the entry journal and then sent to the proper service where it is given a number which also indicates the service, the division, and the group of subjects to which the matter in question belongs.

The registry clerk after numbering the letter enters the letter on a card corresponding to the file of papers and then sends it to the reporter who drafts the reply or the order to be given, and submits it with the approval of his divisional chief to the head of the service who usually signs the papers. The letters received and the copy of the reply signed by the head of the service are sent to the record office.

Each service prepares the ordinary statistics it requires. The general statistics are made out by a special headquarters office.

The accounts department, which, like all the services, sends its statistical data

to the general statistics office, draws up the budget on the basis of the general statistics supplied by this office.

The wages of the staff are got out by the accountants service in accordance with the information supplied by the service to which the employee belongs.

6. — Bulgaria : State Railways and Harbours.

Different measures with the object of facilitating the administrative work are under consideration.

The statistics are drawn up by a special office attached to the commercial section. The headquarters accounts department supplies to the statistical office the material required.

The payment of the staff is fixed by laws which apply indiscriminately to all the employees of the State.

8. — Sweden : Grängesberg-Oxelösund Railways.

The managing director deals with the mail and distributes the letters and documents received. In the case of documents which relate to several services sufficient copies are made for distribution to each.

The statistics are compiled according to prescribed forms, the accountancy and other services assisting in the preparation of the statistics.

The salaries of the staff of the headquarters office are fixed by the accountant's service of the office itself. The pay of workmen in the main shops and the locomotive men is fixed by the headquarters of the rolling stock and traction service.

QUESTION No. 8. — *How is the headquarters office of the operating department organised ?*

How are the rates prepared ?

How are the movement and the distribution of the rolling stock followed up ?

How are the technical offices which

deal in particular with questions of signalling, interlocking, private sidings, etc., organised ?

How are the shunting and the marshalling of trains done ?

Replies.

1. — Germany : German State Railway Company.

The headquarters office of the operating department (Betriebsabteilung) is directed by a manager (member of the management council) assisted by 6 managers (Reichsbahndirektoren) most of whom have received a university education. Each of these managers is assisted by one or two officials (Oberamtmann) having the required qualifications.

All questions relating to construction works are dealt with by a special service under the operating department, staffed by 9 other managers and their assistants.

The operating offices at the area headquarters are organised on the same lines but only questions concerning the actual carrying out of the service are dealt with thereat.

I. Rates for internal traffic.

A) Passenger, luggage and express goods.

The passenger rates on the Reichsbahn are based on distance alone. The supplements for the express trains are calculated by zones up to 300 km. (186 miles) above which distance the supplement is not altered.

In order to get out the journey rates, the tables of distance rates are used, each station having a table of the distances, including all railway connections over which the stations can issue tickets, as well as a table of rates, the same over all the system, which fixes the prices according to the distance in kilometres and which was prepared by the

commercial management (Geschäftsführende Reichsbahndirektion).

In the case of connections with private railways, special rates have been introduced, obtained by combining the ticket rates on the two systems.

B) Goods rates. — a) Standard scale.

The scale of goods rates, 1st part applying over all the system, is divided into two sections A and B. Chapter A contains all general arrangements relating to the goods rates and to the regulations regarding the running of trains over the railway at the same time as the working instructions laid down by the railway administration.

Chapter B contains the general instructions regarding the rates, the classification of goods and the supplementary charges.

The 2nd part of the scale of rates contains the special prescriptions dealing with the rates for distances, the transport taxes, special rates, etc.

b) Special rates.

These rates fixed arbitrarily with the object of giving certain goods or communications over certain railway routes more favourable rates or transport conditions are drawn up on the basis of proposals put forward by the interests concerned, each time higher or national interests make it necessary to depart from the standard rates.

c) Cattle rates.

The fixing of rates for the conveyance of cattle is generally influenced by the same points of view as those considered when deciding the goods rates.

II. — *International rates.*

The bases of the transport conditions over the international railways are supplied by the rates of the different administrations concerned, rates which are so diverse that it is necessary to call together at intervals international conferences in order to draw up transport

regulations and to settle rates to be applied to traffic of this sort.

The international conference of 1924 (I. V. P.) solved many of these problems with the result that the administrations who adopted the conclusions of this conference no longer need draw up international traffic rates except as regards completing certain details (route, language, exchange, division of receipts, etc.).

The time allowed for the turn-round of goods wagons, independently of type, is fixed weekly by the central wagon control, on the basis of the statistical information available.

As regards the carrying out of orders dealing with the distribution of wagons, these are closely followed up throughout the area managements by the controllers under the traffic inspectorates and confirmed by the daily wagon position reports.

In addition, at regular intervals, the central wagon control verifies by its own controllers if the instructions issued have been carried out. At the present time no scheme for modifying the existing organisation for the control, distribution and utilisation of goods wagons is under consideration.

The operating methods used in each shunting yard as regards the time taken and the work done are investigated by certain specialist engineers nominated for the purpose.

The results so obtained are gone into with a view to altering usefully the track, to providing the maximum gradient required for shunting the wagons, etc., in fact to making all suitable arrangements for breaking up the trains and marshalling them rapidly and for enabling the shunting yard to exercise an effective and centralised supervision over the work.

The results of such measures are later on brought together by the statistical service of the shunting yards, which are thereby enabled to give information on

the capacity, operating and shunting costs, and the output of the 107 shunting yards.

By a rational organisation of the operating department, the number of men and locomotives has been reduced in all the areas to an appreciable extent. The shunting operations being better divided out, it has been possible to make great progress in the running of the trains by shortening the time wagons stand in shunting yards and thereby getting a better turn-round of the wagons and getting in front of the traffic requirements.

The supervision of the running of the trains is done with the aid of journey reports, all irregularities noted in these reports being enquired into immediately in order to ascertain the causes and if need be to make good as soon as possible any mistakes.

In addition, a higher train working service (Oberzugleitung) and several operating services specially responsible for looking after the congested areas have been organised at the general management under the operating department management.

Special offices have been set up at some sections with heavy traffic, these offices exercising a general supervision on the train working and acting as traffic regulators.

In addition to the savings resulting from doubling the tracks, these offices have contributed very largely in stimulating a service the efficiency of which has grown in a marked way.

2. — Czechoslovakia : State Railways.

The operating section at the different State Railway headquarters is divided into 8 groups and the commercial section into 5. In addition, at one of the headquarters managements this section has three further groups dealing with rates questions and the manufacture of tickets.

The staff before being employed in

the operating section is trained in rates questions by systematical instruction given at the technical school at each headquarters and at the large stations by the station masters and by the controllers, while at the same time they have to make themselves familiar with the instructions dealing with alterations to the rates.

In order to be able to distribute the goods wagons each day, the numerical stock of the wagons, according to type and to the tonnage, and the receipts of wagons is reported daily at 8 a. m. to the operating sections at the headquarters by the stations, by telephone or by telegram and also in writing in exceptional cases.

The particulars of loaded wagons received at the stations after the return has been made out, but before the allocation orders have been issued, are reported telegraphically by the station concerned to the competent employees of the operating service at the headquarters.

Under each area headquarters there is a workshop in which the repairs and renewals of signalling and safety devices are carried out. This shop has under it the executive staff, that is to say the signalling and interlocking engineers who maintain the mechanical and electrical equipment. At each headquarters there is a self-contained technical unit for the signalling and safety services which draws up the schemes for the construction and the maintenance of the installations. A special section of the operating department at the Ministry of Communications is the supreme authority which controls the activities of these signalling and safety services.

Shunting is done by means of locomotives or by means of the gradients in the shunting yards. The braking of vehicles shunted off is done by the wagon brakes, by brake levers, by brake

pedals and also by track brakes mechanically or electrically controlled.

The running of the trains is followed up : 1. by the stations making use of them; 2. by the dispatching system on most of the main lines, and 3. by services known as time table sections at each headquarters.

In order to use rationally the platform roads in the large passenger stations, the stations are cleared quickly by shunting the trains with the train engines into nearby holding sidings. For the centralised shunting of goods trains, a shunting yard has been built and two others are under construction; further shunting yards are projected.

3. — Rumania : State Railways.

The operating service is divided up into two headquarters : train working and commercial.

The commercial management comprises three services : staff, local and international rates; commercial matters, claims, investigations, etc.

The train working headquarters consist of five services : staff, timetables, control and supervision of the running of the trains, wagons movements and distribution, as well as of wagon balances in international working, technical — of recent creation — which investigates improvements to be introduced to improve the output, and the control inspectorate.

The rates, got out by the rates service, are submitted to a committee formed of the delegates of the interested Ministers and of representatives of industry, agriculture and commerce. The scheme so drawn up has to be approved by the Higher Council of Communications, and subsequently by the Council of Ministers.

The following principles in working up the scales of rates are of an economic and financial nature, the competition of the other methods of transport as well as the interest of the various

national industries (special rates) being taken into account.

The movement and the distribution of wagons is looked after by the central wagon control office, by the distribution offices of the operating inspectorate and by the stations.

All orders are issued by the headquarters service which is in a position to watch and control the circulation, thanks to the information received each day by wire or wireless from the outdoors offices of the inspectorate.

As regards the distribution of the wagons, the stations work on lines fixed by the service instructions.

The technical offices, which look into particular questions relating to signals, interlocking, etc., are under the permanent way maintenance office. At the operating headquarters there is (of recent creation) a technical service which having before it the operating requirements, expresses its views on the improvements to be made to existing installations, or on new installations that should be provided.

Shunting and forming the trains is carried out in the yards by means of shunting locomotives or humps, the wagons being braked by slipper brakes and the brakes on the vehicles.

The train working is followed up by means of the guards' statements. The irregularities noticed are looked into by the control service which takes steps to remedy them.

In order to obtain a more economical utilisation of goods trains the operating inspectorates in agreement with the traction prepare monthly minimum programmes by fixing the minimum number of trains needed for the traffic expected.

The most efficient system for controlling the train movement over sections with heavy traffic is the dispatching system; on the other less important sections selector telephones are used. As regards cases of rational organisation

in the passenger stations and goods yards, there is nothing of importance to point out.

4. — Switzerland : Federal Railways.

The operating is looked after by the head of the operating department, his assistant, the section heads and operating inspectors attached to the area managements, which also supervise the working of the trains with the assistance of the timetables offices.

The rolling stock is distributed by the chief rolling stock controller.

As regards supervising the circulation of the trains, especially as regards delays, an operating inspector has been appointed by the stations and trains division of the general management for this purpose.

A special commission was set up some years ago to enquire into the conditions at each station and to organise the service in the stations as rationally as possible.

The rates applied to goods are based on the volume, weight and value of the goods, the latter consideration playing the deciding part. From the point of view of the cost of transport, a distinction is made between fast and slow goods traffic. The criterion deciding the class into which the goods should go is not so much their economic importance as their commercial value. After taking into account detail costs and the value of the transport, consignment charges and kilometric rates, progressively falling as the distance increases, have been got out. There are also competitive rates and special rates fixed for reasons of national interest. An « *ad valorem* » rate only exists for precious metals, valuable goods (art), etc. The rates include the station charges which cover the work done at the sending and receiving stations, other charges for special purposes (e. g. for the staff) being unknown.

The breaking up and the marshalling

of the trains are carried out in the yards built and equiped for the purpose by means of steam and electric locomotives, or by gravity.

5. — Poland : State Railways.

The organisation of the headquarters office of the operating service is as follows :

The rates are fixed by the commercial and rating department of the Ministry of Communications, in collaboration with the Ministry of Finance, Industry and Commerce, and that of Agriculture. In addition, there is a « rates committee » under the State railway council, a consultative body attached to the Ministry of Communications consisting of representatives of all the public, commercial, and industrial, institutions.

The rolling stock section of the Ministry of Communications deals with the goods wagons which are not allotted to any particular area management, and distributes them to the area managements according to the traffic to be worked.

The passenger vehicles and locomotives are allotted to the area managements and to the respective stations and depots.

The technical offices dealing with matters relating to signals, interlocking, etc., come under the permanent way and works service.

In most of the shunting yards the shunting is done with locomotives; there are some yards in which there are gravity humps or sidings on a gradient. Automatic braking has not yet been introduced.

The actual running of the trains is followed up by means of the guards' statements, and also directly by inspectors, belonging to the trains section of the operating department. In some area managements diagrams are kept which show the actual running of the trains.

No rational organisation of the work

in passenger stations has yet been introduced.

In the goods stations this organisation has been in use for a number of years with the object of making up trains for long distances in order to lessen the time taken, to avoid intermediate shunting, and to reduce the work done by shunting engines. As a result of this rationalisation, the work in all shunting yards as well as the number of such yards has been reduced.

6. — Bulgaria : State Railways and Harbours.

The headquarters of the operating service is the operating department management, directed by a manager, and having the following sections : secretariat, train working, commercial and rates, traction, rolling stock, accounts, budget control, receipts control, and health. Each of these sections is under a chief or assistant and has heads of offices and an executive staff.

The Bulgarian railway rates are established invariably according to the interests of the national production. The transport rates are kilometrage rates, decreasing as the distance increases. In the case of some materials carried in large quantities (such as coal) or which are of great importance from the point of view of the national interest (such as cereals) special rates have been introduced.

The wagon classification office of the operating section fixes the number of wagons and special trains for conveying goods.

All trains are made up in the train marshalling yards. The control of train movements is done by train controllers. The control of passenger trains is specially looked after by the train controllers. In addition the wagon control office attached to the operating section follows the regular running of all the trains by telegraph and telephone. In addition to this daily control of the train movements, every month statistical

tables of the tickets sold, each train being taken separately, are prepared, as well as the monthly statistics of everything occurring on the system.

The rationalisation of the stations has just made a step forward with the introduction and installation of the centralised control of points operation and other technical improvements.

7. — Yugoslavia : State Railways.

The operating service at the general management is made up of two departments :

- 1) train working and traffic,
- 2) commercial,

the first including a traffic division and a rolling stock distribution division.

The stock distribution, like the train working, is supervised by controllers belonging to the general management and to the area managements.

The investigations into questions of signalling, interlocking, etc., come under the works and permanent way maintenance department.

The shunting and the formation of trains is done by means of locomotives, some of the large shunting yard also have the shunting lines on a falling gradient.

QUESTION No. 9. — How are the headquarters administrative offices of the rolling stock and traction department organised ?

Same question as regards the technical offices.

Quote cases of the rational organisation of the work of driving locomotives.

Quote cases of the rational organisation of the work of examining and cleaning carriages.

Mention cases of the rational organisation of the work of examining and disinfecting goods wagons.

Give cases of the rational organisation of the work in the locomotive depots (movement of the locomotives, handling of fuel, repairs, etc.).

Quote cases of the rational organisation of the work in repairing rolling stock (running repairs).

How are the main rolling stock repair shops organised?

Mention other improvements introduced in the working methods in these shops.

How are the stores organised? What methods have been introduced as regards taking stores into stock, handling the material, and checking the stock?

Replies.

1. — Germany: German State Railway Company.

The division of the *technical locomotive service* (Maschinentechnischen Abteilung) of the general management corresponds to the division of the other services.

The proposed measures for the rational organisation of the traction service can be grouped into two categories:

- A) those which affect the operating;
- B) those concerning the shops.

So that the trains may be worked satisfactory and as cheaply as possible, the following measures have been ordered:

a) use of such types of locomotives as suit the class and tonnage of the trains they have to work;

b) working over as long distances as possible without change of locomotive, which can be done if the type of locomotive used be properly selected for the work required of it. The locomotives of express trains cover as much as 500 km. (310 miles) in a single journey, ordinary passenger trains 400 km. (248 miles), and goods trains 300 km. (186 miles);

c) the double and triple consecutive utilisation of the locomotive (by means

of two or three sets of men) which has the result of appreciably increasing the distance run by the locomotive as well as the work of the locomotive men.

Most of the locomotives are in this way used for two consecutive turns of duty in shunting and suburban service, and often for three turns;

d) the introduction of premiums for fuel saving, which has resulted in the consumption falling;

e) the introduction of premiums for increased mileage worked between two heavy repairs.

In the same way the system, when well thought out, of working locomotives with two regular sets of men results in practice in better use being made of them.

The results obtained through the application of the above mentioned measures and the appreciable reduction in operating costs justify the opinion that no important improvement in the organisation of this service is likely in the future.

The problem of making a greater use of the rail motor vehicles is at the present time under consideration by the Reichsbahn.

Beside the measures mentioned the organisation of the locomotive service has been further improved by close collaboration with the operating service properly speaking and with the shops service.

In all the shops the progress of work has been standardised. The output was then made to suit the operating needs thereby getting at the same time as a reduction in the time taken to carry out the repairs, a reduction in costs.

A further progress of the same kind has been the repairing at each depot of as few types of locomotive as possible, with all the advantages resulting therefrom, and finally over the whole railway system the reduction in the number

of types of locomotives used and their standardisation.

A) Measures affecting the working of passenger vehicles.

a) better utilisation of the passenger stock;

b) increase in the period between repairs;

c) greater utilisation of the wagons, their cleaning by the mechanisation of the methods of washing being more effective, quicker, and cheaper; and finally,

d) efforts made to increase the distance run between repairs.

B) Measures concerning the shops.

By applying methods similar to those introduced at the shops attached to the locomotive depots, identical results have been obtained namely: reduction in the time spent on repairs, which means a smaller reserve of wagons, reduction in repair cost, etc.

A) Measures relating to the working of goods wagons:

a) better utilisation of the wagons;

b) preliminary cleansing of the wagons by hot water jets prior to disinfection;

c) reduction in the cost of cleaning and disinfection.

At the present time no other innovations are being considered.

B) Measures applicable to the work-shops.

By continually improving the quality of the repair work the time between two periodical repairs has been brought within the scheduled period.

In the case of wagons used in seasonal traffic, the interval between general repairs has been extended to three years and over, which in practice has meant a reduction in the maintenance costs of the whole stock of wagons.

As regards measures relating to the

rational organisation of work in the locomotive depots may be mentioned:

A) Measures concerning the operation:

a) increased output; locomotives turned out quickly for the trains to be worked;

b) mechanisation of operations which were done manually (electrification of the driving gear of turntables, of cranes, of tranship stations; installation of electric or steam cranes for handling coal, ashes, and char, arrangements whereby the grates and ashpans dump directly into the ash pits);

B) Measures affecting the shops:

a) allocation to the depots to the extent possible of a smaller number of locomotives and improvement in the conditions under which the various works are carried out based on investigations confirmed by practice; making good any weakness in the organisation, etc.;

b) calculation of the most rational limit to be fixed as regards the time taken for repairs carried out in the depots and main shops;

c) reduction in the number of depot shops, either by amalgamation or by suppressing some of them.

As regards measures concerning the rational organisation of the work of maintaining the rolling stock, the following may be quoted:

a) the economical limit between the repairs and the renewal of the vehicles has been determined for each case considered separately;

b) the maintenance of the stock has been systematised by drawing up work programmes;

c) the design of parts and the material used have been altered whenever it has been found that the degree of wear exceeded the limits expected;

d) standard works programmes deal-

ing with the maintenance of the vehicles have been drawn up based on the logical sequence of operations which should be followed in the mass production of spare parts;

e) arrangements have been made to bring the vehicles in for repair systematically in agreement with the operating departments, so as to be able to run the workshops on rational lines;

f) systematic inspections during the course of the repairs have been introduced to make sure that the work done is in accordance with the requirements;

g) statistics have been prepared showing the cost of repairs related to the unit of time;

h) investigations have been made into the rates of wear in order to determine the manufacturing methods, to be adopted in view of the degree of wear revealed.

As from 1925, the shops specialised to deal with certain types of vehicles have been organised as repair shops. These shops have at their head a manager who is over the different departments of the shop, grouped in the form of services attached to the management, as well as over the operating services which control the operating properly speaking, or the different repairs of the vehicles.

With the object of reducing the production costs the specialisation of certain work has been carried very far, both by the creation of special sections for carrying out the work (such as brass foundries, timber drying plants, tyre shops, or staymaking shops, etc.) and by the institution of special investigation services (laboratories, etc.) where everything entering into the construction and maintenance of the vehicles is tested.

The main repair shops are controlled by the workshops services which are separate services under certain area

headquarters and which have authority over the principal shops belonging to several managements. The headquarters over all the principal workshops of the railway system is the technical locomotive service (Maschinentechnischen Abteilung) at the general headquarters.

The improvements introduced in the working methods and conditions in the main workshops can be summed up in what is understood by « rationalisation of work ».

The improvements have made it possible to reduce the cost of repairs to an appreciable extent and to increase the production of the shops.

The stores department (coal, coke, briquettes, spares, etc.), are divided into main headquarters stores (Hauptlager) which obtain their supplies directly from the producing centres and into the secondary stores (Nebenlager) usually at the consuming centres and which are fed by the main stores.

In the manufacturing sections of the main repair shops there are stores for the ordinary run of material used in these sections; these stores are fed by the main stores of the shop in question.

The main stores at the shops have two distinct sections :

1. consumable stores controlled by an administrative employee;
2. spare parts controlled by a technical employee.

The general control of the main stores at the main repair shops is exercised by a special service. The management of the principal stores and that of the large secondary stores is under a special managing staff assisted by the necessary clerical staff, issuing staff, supervisory staff, etc.

The secondary stores are administered by the head of the stores service in person.

The administrative staff of the stores is replaced every five years.

The materials are stocked into the stores in accordance with the technical conditions governing all operations of this kind.

The control of materials received and issued, the determination of the consumption and the reserve stock is done by means of registers which show the receipts and issues, the stock position being balanced monthly, a stock return being made out quarterly.

As regards checking the variations in the different stocks of materials, cards are made out for the materials and the spare parts required by the shops.

The quarterly returns are made out from the register of receipts and issues of materials and this makes it possible to ascertain both the stocks in reserve and the annual consumption.

As it has been necessary to take into account the present financial conditions, the necessity of introducing a new method of dealing with materials has been admitted.

When applying the new methods intended to introduce certain improvements in the stores, new regulations have been drawn up based on the mechanisation of the accountancy work.

2. — Czechoslovakia : State Railways.

The organisation of the headquarters offices is as follows:

a) Each area management of the State Railways has a section common to the traction and shops service, consisting of 6 to 7 groups;

b) As regards the technical and locomotive services, there are self-contained departments at the Ministry of Railways which deal from the technical and administrative points of view with questions relating to the traction and to the control of the stock.

When diagramming the engine workings the principle on which they are based is that of getting as long turns as possible, so that the time taken for auxiliary work (putting away, placing

in reserve or putting in the shed) may be relatively smaller. The legal prescriptions relative to the period of work (a maximum of 192 hours in 4 weeks, the turn of duty worked by each set of men, including auxiliary work — being limited to 9 hours on fast trains, 11 hours on stopping trains, 14 hours on goods trains, and 16 hours in the case of light railways, a period which, subject to the staff agreeing, may be extended one hour) are complied with.

The day's work also includes, over the time working trains : the times fixed for getting the engine ready and for putting it away in the shed; for reasons of economy the locomotives coming into the shed are put away by a special set of men.

The number of drivers is maintained at the level which suits the normal traffic conditions. In case of a sudden rush of traffic the holidays are reduced and the less important work such as shunting is covered by passed drivers.

If the traffic falls however, the surplus drivers are used as firemen, and the surplus firemen as workmen : as regards the workmen proper, if work cannot be found for them, they are discharged.

The inside and outside cleaning of passenger carriages is done when the vehicles are periodically overhauled.

To deal with repairs to the vehicles, there are two main shops as well as other repair shops. In the former the heavy repairs of locomotives are carried out : here too, the legal inspections of the boilers are carried out and if needed the boilers are repaired. The same procedure is followed in the case of the carriages and wagons. Examinations and repairs to vehicles in traffic are also carried out in the repair shops.

The reorganisation of the shops has been carried out in two ways :

1. by the alteration of the way the work is carried out, which has been

effected by dividing the work between different gangs;

2. by the limitation of the sphere of activity of different control organisations in accordance with the division of the work.

Finally, regulations, work orders, premium tickets, and following up cards have been prepared on the basis of which the different stages of the repair have been established scientifically.

In order to control the work, a number of sections, each under its own head, such as the technical office, the inspection office, the operating section properly speaking, and the accounts office have been organised at the workshops. Each section of the shops has a detail stores attached to it.

This organisation has given excellent results, such as an increased output of repairs or manufacture, as well as an appreciable reduction in the time taken by the repairs and in the costs.

As a consequence of this organisation the reserve stock of vehicles is always being reduced.

The improvements introduced into the different working methods must also be quoted here :

1. Spray painting of the locomotives, tenders, passenger carriages and goods vehicles which formerly required considerable time when hand painted with brushes.

2. Suppression of the costly and profitless transport of parts to outlying points and providing everywhere the equipment needed.

3. Introduction of measuring devices for obtaining the leading dimensions and the distances between centres on the locomotives and tenders.

4. In order to maintain the tolerances prescribed for the manufactured parts it has also been necessary to lay down the tolerances for the principal machine tools [according to the Czechoslovakian

(C. S. D.) or German (D. I. N.) standards].

5. Automatic machines are used for different processes.

6. Work diagrams and time graphs have been got out so as to get better use out of the mechanical equipment.

7. Standard testing and inspection offices have been provided at the workshops.

8. The machine tools are being provided with pneumatic tool holders which have given excellent results.

Tests are also being made as regards the savings to be effected by welding and on its safe use, the use of coal gas in place of acetylene, for cutting, the use of liquid oxygen and high pressure acetylene, autogenous welding combined with electric welding. X ray testing of materials, the method of revealing fissures in axles and journals by electromagnetic methods, the electric heating of tyres, and electric furnaces have been introduced.

Special attention has been devoted to the electric welding of tyres.

The supply of materials required by the services is assured by the 16 self-contained stores and the 6 shop stores; the number may be reduced.

The stationary is issued by three stationary stores. The service of the supply stores is divided into :

1. Handling;
2. Accountancy;
3. Clerical.

The three services deal with the ordering, reception and distribution of stores, the accountancy work, the registering in of supplies and the control of the stores.

These large stores feed the smaller stores, which are distributed over the whole of the railway system.

By this organisation the services are supplied with stores in a satisfactory

manner, the stocks of stores being always sufficient to meet the consumption.

3. — Rumania : State Railways.

The rolling stock and traction department is controlled by two separate headquarters; A) traction, B) workshops and rolling stock.

A. — The traction headquarters, so far as it is a headquarters organisation, is constituted as follows :

A manager and two assistant managers (these latter specially responsible for the supervision and organisation of certain sections) have under their orders 6 special services namely :

1. staff, purely administrative;
2. technical, for questions of installation and construction at the depots and sheds;
3. maintenance and operation of locomotives;
4. stores and fuel;
5. maintenance and working of water pumping stations for locomotive water supplies as well as the construction and works projected in connection with water supplies;
6. tests and designs (in course of institution).

Amongst the rational methods of work put into practice may be mentioned the monthly returns dealing with the working of the locomotives at the depots prepared from the cards centralised in the statistical office of the traction headquarters.

The measures ordered by the traction service for improving the locomotive operating conditions may be summed up in the following order :

1. maximum utilisation of the locomotives :

- a) runs as long as possible;
- b) alternative use rationally organised;

- c) double consecutive turns of duty with two sets of men.

At the same time as the rationalisation of the installations important work in the way of mechanisation of various equipment in the locomotive depots has been carried out, or is still in some cases in progress, and this has greatly improved the working conditions both as regards the operation and the upkeep of the locomotives.

A most interesting problem, owing to the prospects it opens up, under consideration since 1921 but the solution of which makes slow progress owing to the difficult after-war financial conditions, is that of the progressive reduction in the number of types of locomotives.

As regards locomotive repairs, they have been standardised as follows :

1. monthly, quarterly, and half-yearly periodical overhauls which can be done in the shops (of the depots) and under the operating department.
2. general repairs every 18 months and at intervals of 5 years, in the main repair shops according to a programme of rational allocation of certain types of locomotives to the shops under the operating department.

B. — The shops and rolling stock management which directly controls 10 main shops, 3 groups of small shops, and a shop for manufacturing repair parts, consists of six services :

1. the operating service, which draws up repair programmes for the use of the shops as well as organising the professional instruction of the staff whilst dealing with all administrative questions affecting them.

2. vehicle designs office.

3. shops drawing offices in connection with works equipment and projected new shops.

4. inspection of rolling stock after

repair whether in the company's shops or in private shops.

5. rationalisation and repair of wagons.

6. supply of materials so far as the technical side is concerned, the commercial part being handled by the stores department.

In the marshalling yards and yards where trains are made up to destination, as in the intermediate stations of small size, the wagons are attended to by repairers appointed for the purpose.

The interior condition of the passenger coaches in the train sets running over the main lines is kept in good order by train attendants travelling with the coaches.

Cleaning and washing as well as certain carriage repairs are covered by special gangs in the train formation yards suitably equipped for these purposes.

In the case of goods wagons, the running repairs are carried out in the large stations by the repairers appointed for the purpose. As regards cleaning and disinfecting goods trains, no special equipment is as yet available, those operations being carried out generally, though in rather an incomplete manner, in all stations before loading, and thoroughly when the wagons go into the shops for medium or heavy repairs.

A main repair shop is managed by a technical superintendent with the help of the administrative offices and the technical operating and inspecting offices.

The *operating office* has to regulate the work under its many aspects (estimates, work sheets, and cards showing the position of the work in hand, etc.) taking timings of all operations, notably those needed in arriving at an agreed price.

The *inspection office* besides passing out repaired vehicles, also supervises

the strict applications of the working programmes.

The present organisation of the main workshops has made it possible to reach an advanced stage of specialisation in the work, whilst harmonising the progress of the work in all the different sections of the shop.

The standardisation of a part of the spare parts for vehicles (the work not yet being fully developed) has made it possible to manufacture the said parts in series.

Owing to the large number of types of vehicles in the stock of carriages of the State railways, the shops have been specialised in the repair of certain types which has resulted in the repair time being reduced. In addition the work of specialising some shops on the manufacture of spares is in hand at the present time.

4. — Switzerland : Federal Railways.

The traction shops service of the general management is responsible for the acquisition of all rolling stock and its manufacture in the works; it supervises also the traction service in the areas.

At general headquarters as in the areas the administrative and technical services of the traction division work in close collaboration. The traction and shops division of the general headquarters is divided into 5 sections : acquisition of rolling stock, maintenance of rolling stock (shops), traction, service dealing with international matters, and secretariat. In the traction service of the area headquarters there is a section for the technical service, a staff office and an office dealing with accounts and stores.

The highest rated drivers and assistant drivers are used as far as possible on train work and not on shed work. The electric motor vehicles are driven by one man except in the case of express and night trains. The turns of duty of the men are not based on

the locomotive workings as in this way greater use can be made of these latter and the work of the enginemen better arranged.

In the case of through and stopping trains, the carriages are examined once a day only at a specified station. As regards cleaning the coaches, provision is made for :

- a) thorough cleaning (periodical cleaning);
- b) daily cleaning; and
- c) wipe over.

The work to be done under these headings has been laid down in detail.

The examination of goods trains is limited as far as possible to the regulation examination on arrival. Each station is provided with the equipment needed for washing the wagons and for disinfecting them.

As regards the rational organisation of the work in the locomotive depots, the following cases may be quoted : closing the repair shops at less important depots, centralisation of repairs at the large depot repair shops, standardisation of replacement parts, reorganisation of the stores, and modernisation of the mechanical equipment.

The six main shops have been specially equipped for the maintenance of rolling stock.

The management of the five offices, the stores and the three divisions of a main workshop is placed in the hands of a workshop superintendent (an engineer).

The five offices are : technical, orders, administrative, accounts and stores.

The three divisions are : locomotives, carriages and wagons, and general. These divisions are divided up into a number of subdivisions when necessary to distribute the work rationally.

Among the improvements introduced into the workshop service may be men-

tioned : the reorganisation of the administrative work, the introduction of a new accounts system and a new stores control, the rationalisation of the work (belt system for repairing carriages and wagons), and spray painting.

A store is attached to each main repair shop, and by means of a simple control system and exact statistics of the supplies received, it has been found possible to prevent misuse or pilfering.

The stores department maintains in the different areas stores which are kept supplied with the materials needed by the operating and permanent way services. The stores supplying electrical materials, and for supplying the shops and the rolling stock services are not directly under the chief stores superintendent, but come under their own respective departments.

5. — Poland : State Railways.

Besides the headquarters offices of the mechanical services (traction) at the headquarters management (Ministry of Communications) each area management has its own mechanical service with the following divisions : general, locomotives, carriages and wagons, technical, high tension currents, by which the outdoors service, the sections of the mechanical service with the shops and locomotive depots are controlled.

The rational organisation of the work as regards driving the locomotives, inspection, cleaning and disinfection of the passenger coaches and goods wagons, in the locomotive depots, in the rolling stock repair shops, as well as the organisation of the stores is at the present time under consideration by a travelling committee of enquiry.

As regards the main shops, they are being reorganised scientifically as regards their administration and the system of working. In the administrative field, the supervision and the executive work of the shops are separated from

the sections deciding the work to be done.

The reorganisation of the system of work is based on the following fundamental bases :

a) introduction of detailed work lists for the different repairs;

b) strict specialisation of the work between the gangs and even as between workmen;

c) exact obedience to the programme and the time of the work;

d) working on the belt system and standardisation as far as possible of the different elements of the work;

e) improvement of specifications;

f) better use of machine tools according to their capabilities;

g) improvement of the means of transport in the shops;

h) improvement of tool rooms, standardisation of tools and of the steels used to make them;

i) improvement and standardisation of the stores required by the shops.

The progress attained is very great, and is seen in :

a) appreciable increase in the number of vehicles repaired yearly;

b) reduction in the percentage of rolling stock out of service;

c) reduction in the time needed to repair the vehicles;

d) increase in the average mileage of locomotives between two general repairs;

e) reduction in the average amount of work expressed in hours involved in a heavy repair to the vehicles.

6. — Bulgaria : State Railways and Harbours.

As regards the organisation of the headquarters offices of the rolling stock and traction service see the reply to Question No. 4.

Different measures have been introduced in order to facilitate the engine-men's duties, by providing other men to help in washing out and taking water and coal.

In order to be able to examine all the vehicles, gas them, wash and clean them, as well as do minor repairs quickly, a special site has been provided with parallel tracks with cleaning pits, etc.

Provision has been made for the future installation of a special plant for washing and disinfecting goods wagons. In the locomotive depots traversers or turntables are used and a special plant has been put down for coaling the locomotives.

7. — Yugoslavia : State Railways.

The rolling stock and traction department consists of the following divisions:

1. traction; 2. shops; 3. works; and 4. electrical.

The work of the administrative offices is not completely separated from the technical work.

The administrative work is most often covered by the traction and shops division.

Technical questions are dealt with by the works and electrical divisions.

The rationalisation of the different branches of the service is in course of realisation.

The organisation of the locomotive depots and of the shops as well as the organisation of the work of cleaning and maintaining the coaches and wagons are similar to those of most railway administrations.

There is a large central stores for the whole system which feeds the stores attached to the workshops. In addition each service unit of the line has its local stores. The stores and the handling of the stores are organised in such a way as to facilitate the control of the stocks.

8. — Sweden : Grängesberg-Oxelösund
Railways.

In some of the main workshops the belt system has been in use for some years, it being used in essentially the same way as in the main shops of the Reichsbahn.

As a result of this system, when applied to the repairs of passenger and goods stock, the capacity of these shops has been considerably increased, the number of vehicles repaired per man per year having increased from 10.4 in 1927 to 15.76 in 1930. In addition the time for the repair of a wagon has been reduced from 11.6 days in 1927 to 7.1 days in 1930.

As a result this system will be probably applied in a few years to the work done by the other main shops of the State Railways.

QUESTION No. 10. — *Ways and works department.*

How have you organised the headquarters administrative offices of the permanent way department?

The same question as regards the technical offices.

Quote cases of the rational organisation of work in the examination and maintenance of the permanent way and works.

How is the work of the travelling workshops and in the shops organised?

How are the stores organised?

Replies.

1. — Germany : German State Railway
Company.

The organisation of the headquarters administrative and technical offices has been described in the reply to Question No. 5.

As regards the measures taken for the rational organisation of the work in conjunction with the works and permanent way repair service, these mea-

sures were examined and discussed during the International Railway Congress at Madrid in 1930.

Since that date no further cases of rational methods of work based on the same principles have been introduced on the Reichsbahn.

Mention may however be made of special trolleys for handling completely fitted up points and crossings.

The Reichsbahn has however found it possible by suitable methods to restore to use worn materials and has succeeded in getting very encouraging results in this direction.

As regards the repairs, maintenance and construction of buildings, no new methods worthy of mention have been introduced.

We may however mention in this connection the saving obtained when taking in hand and carrying out works since certain standards have been adopted and certain prescriptions followed, these prescriptions having been got out by a commission of the Reichsbahn appointed for the purpose; these standards are however of greater importance for new works than in connection with existing structures and apply less to operating buildings than to houses.

In addition to the materials used in the track, most of the area managements have in connection with the creosoting plants, sleeper depots where the sleepers remain stacked until completely impregnated. These depots are fitted with the equipment and machine tools required for dealing with sleepers. These depots have supplies of smaller permanent way stores (such as fishplates bolts, fishplates, coachscrews, etc.).

To meet the needs of each area management, there is a main depot of new track materials situated whenever possible near the consuming centres and which supplies these centres with the necessary materials.

Old materials are stacked in these depots provided they are usable. The rails and sleepers are the only new permanent way materials sent directly to the using points so as to avoid additional handling.

The small stores are however dealt with first of all in the depot stores where they can be kept under good conditions and be distributed therefrom according to needs. With old permanent way material recovered when relaying or from ordinary maintenance, the same procedure is followed, i. e. the usable rails and sleepers are sent directly to the using points. As regards the small stores these are sent to the depots in bulk where they are divided up as follows: firstly the usable material without any prior work is sorted out, then that requiring some work to make it usable (work which is done according to certain standards); then the unserviceable part remaining is taken and disposed of.

The stocking of all new and used materials is done in accordance with the shape and nature of the material, the stock situation being kept up to date by means of cards.

The control and administration of the stock of permanent way materials at a depot is done by mechanical means. Generally the permanent way stores are administered according to instructions from general headquarters, which have to look after the needs of each area management while looking after the adjustments to be made in the existing stocks and at the same time estimating the new stock to be obtained.

2. — Czechoslovakia : State Railways.

From the administrative and technical points of view the headquarters offices of the maintenance of the permanent way and buildings department are the following :

a) a special department at the Min-

istry of Railways responsible for the control and maintenance of the track;

b) a maintenance section at the managements consisting of 8 groups of services.

To improve the output of the permanent way repair staff it is proposed to introduce a system of premiums based on competition between the different gangs, so that they as well as the organisations over them shall have greater interest in the amount of work done.

There are no travelling repair shops except in the case of the bridge gangs and those responsible for repairing weighbridges; these have fully equipped vans and tool equipment.

At one of the permanent way maintenance sections a central stores has been set up and all excess materials from the other sections are sent in to it, the stores of these other sections only holding the quantities of materials strictly necessary.

All materials recovered when renewing or repairing the track are also sent into this central stores where these materials are sorted out.

The other permanent way maintenance sections are quickly and efficiently provided with the materials required through this central stores. This centralisation has given very good results and has made it possible to reduce the stocks of stores.

3. — Rumania : State Railways.

The permanent way and works maintenance department has as its headquarters administration, the works and maintenance department headquarters, with the services belonging thereto which are the following: administrative (staff, accounts and rationalisation), maintenance (maintenance and centralisation), new works, and technical (bridges and tunnels, works and installations, architecture).

The outdoors service of the mainten-

ance and works department is looked after by the maintenance inspectorates which control the work through the maintenance sections and district organisations.

The track and structures are inspected by the platelayers each day, at intervals of 4 to 5 days by the district foremen (picheri), and monthly by the heads of the maintenance sections and inspectors.

The detailed overhaul of the bridges is done by a special gang attached to each maintenance inspectorate.

General organisation of the depots and stores.

The stores department headquarters in its capacity of the sole organisation having administrative and technical initiative deals with the selection of the materials for quality, the preparation of specifications, the management of the stores and as the only qualified commercial agent makes purchases from industrial and commercial sources, being assisted in all that has to do with the technical part (specifications, standardisation) by the other headquarters managements.

General stores.

1. a) The main stores which supply stores to all the other small stores and the other services in the area of one or several groups of inspectorates.

b) Central stores at the principal repair workshops which supply stores to the unit to which they are attached and at the same time to the other services, chiefly as regards materials in metal.

Small stores.

2. a) Small stores at the small shops dealing with wagon repairs.

b) Small stores which supply stores to the maintenance sections, and

c) Small stores at the locomotive depots.

The materials are also arranged in the stores in the easiest way for dealing with each of the different materials separately. The system whereby the cards show the actual balance at any moment is based partly on the stores system of the Belgian National Railway Company and is used in conjunction with ledger cards placed against the stocks which show all information relating to the stores in stock, such as dates of receipts and issues, the daily balance, the quarterly requisitions for stores, etc. The stocks of stores are checked periodically and by surprise visits by staff from the stores department headquarters.

4. — Switzerland : Federal Railways.

At general headquarters the permanent way department with its sections: permanent way material, safety equipment, bridges, formation, buildings and administrative, is under a chief engineer.

At the area managements a chief engineer looks after the management of the permanent way and works department, which has the same sections as at general headquarters less the bridge section.

The maintenance of the permanent way in an area [936-994 km. (581-618 miles)] is supervised by 5 to 6 permanent way engineers [91-198 km. (57-123 miles)] each assisted by 3 to 5 districts engineers [13-54 km. (8-33.5 miles)], the latter having under their orders 9 to 10 foremen platelayers who supervise the permanent way work in progress.

The area service dealing with the formation in the area consists of 4 offices: a) statistics with its bridges staff; b) technical; c) surveyors; and d) drawing stores and printing office.

The area equipment and safety service has two offices: a) interlocking and safety devices; and b) block installations. The work in connection with the block system is carried out by the

staff of the interlocking service and the interlocking construction gangs.

The area management also includes, independently of the permanent way and works service, the electrification service with its offices, technical staff, and supervisors of the electrical installations.

5. — Poland : State Railways.

The Ministry of Communications through its department of the way and works service which is the headquarters authority, controls and supervises both administratively and technically the whole of the railway system. The divisions of the permanent way and works service under an area headquarters are the following : a) general; b) formation and bridges; c) permanent way and stations; d) buildings; e) protection of train movements. These divisions supervise the outdoors service, i. e. the sections subdivided into districts of the line.

A rational organisation of the work in the way and works department is at the present time being considered.

6. — Bulgaria : State Railways and Harbours.

The headquarters of the way and works department is under a chief engineer.

At the head of each office of the headquarters service there is as a rule an engineer in charge.

An engineer is also at the head of the permanent way maintenance sections.

7. — Jugoslavia : State Railways.

The portion of the system under each area management is divided into sections of 100 to 210 km. (62 to 130 miles) of track. Each section has its stores, a carpenter's shop, and a fitter's shop.

Each area management has its workshop for rebuilding and repairing metal bridges and points and crossings, as well as a shop for repairing and making

safety devices, such as the block system equipment, telegraphs, and telephones.

8. — Sweden : Grängesberg-Oxelösund Railways.

No reply was sent to this question.

CHAPTER III.

Improvements obtained by standardising dimensions and materials (spare parts and units used by the railway) (Standardisation).

QUESTION No. 11. — *State the progress made in the standardisation of locomotive spares or units.*

Same question relatively to the tenders.

Are worn parts repaired to standard sizes possibly different from those of new parts?

Have the tolerances both for new parts and for spares been standardised?

Replies.

1. — Germany : German State Railway Company.

The question raised at the 1920 meeting of the German railways whether the type of locomotive to be built should be to existing types or to entirely new designs was settled by the decision to build new types only with the object of more easily standardising the locomotive details and units, and also to meet the increasingly difficult traffic conditions.

In order to get out the designs of the new types, a special office for the standardisation of the construction methods was set up in Berlin under the « Union of German Locomotive Builders » working in the closest collaboration with the Reichsbahn headquarters. In carrying out this great undertaking and with the object of carrying standardisation as far as possible the stan-

dards of the German industry (D. I. N.) and those fixed in 1918 by a commission on the standardisation of locomotives were used to the maximum extent. Up to the present time 14 types of standard locomotives (12 for standard and 2 for narrow gauge) have been introduced in which the great number of the ordinary parts and units (springs, tube plates, handles, crossheads, slide valves, etc.) has been reduced to 4 or 5 designs for each part or unit.

The equipment (Anrüstung) large or small is, however, the same on all these types of locomotives.

The standardisation of the materials used in the construction of the locomotives was felt to be of equal importance. Much work has been done in this direction and a part only of the German industrial standards (D. I. N.) has been adopted.

In addition to the standardisation of parts, units, and materials for new locomotives, the standardisation of spares for the old locomotives has been taken in hand. Commencing with parts requiring finer work and with pipe screw threads the number of which has been considerably reduced, the work was continued by standardising such parts as: grates, buffers, manhole covers, pins, and also brasses, slide bars, etc. The whole of the standardisation is on the point of being completed for all the old types of locomotives.

When carrying out this standardisation care was taken always to make sure that the standardised parts could be used on the old locomotives.

The final object of standardisation, i. e. the reduction in the costs of manufacture and repair was completely attained when it became possible to manufacture standard interchange parts and this was made possible by adopting for the construction of locomotives the system of gauging based on the hole being standard (Einheitsbohrung).

As regards new parts, interchangea-

bility was ensured by strictly observing the working dimensions and limits laid down in the lists of tolerances used on the standard locomotives (Toleranzvorschriften für Einheitslok). The working drawings are dimensioned in accordance with these prescriptions.

As regards parts subject to wear, the amount of wear allowable has been laid down; once this limit is exceeded the parts are repaired or renewed.

It is most important to see that the principal dimensions and the dimensions of the axles are maintained; for this purpose special instructions have been drawn up in accordance with which the boilers, the frames, the wheels and axles, the valve gear, the slide bars, the cylinders, etc., have to be checked up, although they are measured over at each repair.

The advantages obtained, both in working and in the repair shops by the standardisation of the types of locomotive, by the standardisation of the spare parts followed by their mass production are so considerable that the extra cost incurred from the commencement of the work of standardisation has been more than covered, the future promising very considerable savings under this heading.

In the standardisation of the tenders the same measures were adopted as in the case of the locomotives. For each part both the manufacturing dimensions (Herstellungsmass) and the repair dimensions (Werkgrenzmass) were definitely fixed. In the case of a heavy repair to a vehicle, the parts which are worn below the limit laid down for repairs are replaced or restored to the original dimensions; in the case of a partial repair, this operation depends on the repair limit; when a part has reached the limit of wear it is renewed.

2. — Czechoslovakia: State Railways.

The locomotive committee on the standardisation commission (C. E. N.)

has looked into and solved the following standardisation questions affecting locomotives and tenders :

1. drawings;
2. basic technical standards (diameter of fits, standard lengths, degree of conicity, radii of threads, etc.);
3. standardisation of the different parts;
4. scales of tolerances (to make mass production possible); standard dimensions for repair parts have not yet been arrived at;
5. tolerances of locomotive parts, boilers and frames;
6. standardisation of the different sorts of materials with the object of facilitating ordering and inspection.

3. — Rumania : State Railways.

The standardisation of locomotive and tender spare parts and units has not been done in the case of new types of locomotives, the number of which has been reduced to a few types only. In the case of the old locomotives of the Rumanian Railways representing 117 different types, mostly from foreign administrations, parts of whose railway systems passed to Rumania after the war, the standardisation of spares has met with great difficulties.

Certain work has however been done in this direction and a beginning was made by reducing the existing types from 117 to 84 by scrapping the worn out locomotives and by suppressing the types of little value.

The tools for this class of work have been standardised as well as certain parts and certain materials needed for the different repairs (such as axle boxes, bolts, glass, steel rolled sections, copper alloys, anti-friction metals, etc.).

As regards the repaired dimensions of worn parts, they are only standardised as regards the maximum limit of wear; when this limit is exceeded the parts in question are replaced.

In the case of new parts, the dimensions and tolerances are shown in the working drawings; for the constructional parts, such as plates, tubes, etc., the German standards (D. I. N.) are used.

4. — Switzerland : Federal Railways.

Since 1920 the following parts of the electric locomotives have been standardised : collectors (pantograph complete as regards interchangeability), current collector switches; earthing switches; transformers; relays; measuring instruments; lighting and heating; switches and couplings for train heating; coupling and various equipment for multiple control; distance switches; safety devices; motors of auxiliary circuits; dynamos for service and lighting circuits; safety devices for one-man locomotive operation; cables; casings; different spare parts; traction motors and individual axle drives; draw and buffing gear; springs, etc.

In order not to hinder the free development of design, only parts which will enable the costs of repairs to be reduced and the safety in operation increased, will be standardised in future.

Nothing further will be done in the standardising of steam locomotives and tenders as these machines are gradually being taken out of service and replaced by electric locomotives.

Worn parts are repaired to dimensions differing from those of new parts only in certain particular cases when a saving will undoubtedly be obtained thereby.

In the case of essential parts of the electric motor vehicles the tolerances have been standardised following the standard sheets of the Swiss Association of Engine Manufacturers.

5. — Poland : State Railways.

The following parts have been standardised : the boiler fittings and mount-

ings, whole series of 300 locomotive details.

The Standardisation Commission is continuing its work and shortly a further 300 locomotive details will be standardised as well as the manufacturing and wear tolerances.

As regards the standardisation of tender details, of the dimensions of worn and repaired parts, and of tolerances for new and spare parts, the problem is under investigation.

6. — Bulgaria : State Railways and Harbours.

The railway management has standardised a certain number of parts of the 35 locomotives delivered in 1930 and 1931, namely : the boilers and their fittings, the leading carrying axles, the couplings and buffers, and the tenders.

In the case of the other locomotives and tenders, there are no standard dimensions, neither have tolerances for new and spare parts been standardised.

7. — Yugoslavia : State Railways.

The standardisation of spare parts of locomotives, and of tenders, has been delayed owing to the great number of types inherited from the former managements.

This standardisation is only being applied to new parts.

The same difficulties have also delayed the introduction of standard tolerances.

8. — Sweden : Grängesberg-Oxelösund Railways.

No reply has been received on this question.

QUESTION No. 12. — *Indicate the progress made in standardising spare parts for passenger carriages.*

Same question as regards goods wagons.

Are worn parts restored to standard

dimensions other than those of new parts ?

Have the tolerances been standardised for new parts as well as for repaired parts ?

Replies.

1. — Germany : German State Railway Company.

In view of the standardisation of the main types of wagons, the standardisation of parts was first of all applied to new construction because alterations to the large number of carriages in service was not possible in practice, for financial reasons.

The standardisation of new designs of carriages applies to all construction parts, beginning with those having to fulfil the same purpose.

This standardisation was also inspired by the German industrial standards (D, I. N.); this time, however, fewer of these were used.

Where these standards do not meet requirements new standards were determined in agreement with the German committee for the standardisation of wagons, which will be applied to all wagons, which may have to be built (Wanormen).

The standardisation of parts has been carried much further, even as far as standardising unions and connections.

The spare parts for old wagons which are used in units the standardisation of which was practically impossible and which, being subject to greater wear and in consequence more frequently asked for, are manufactured on the same principles, so that these parts also may be considered as standardised and interchangeable.

These parts are introduced into non-standard old wagons either when altering units for service reasons, or when carrying out repairs by replacing worn parts. The standardisation of old pas-

senger vehicles is not yet complete, although when carrying out repairs, standardised parts are used in most cases as far as possible.

In addition to borrowed standards from the German industry and the designs used for the standard manufacture of the standard wagon parts which give the manufacturing dimensions and tolerances, the Reichsbahn has provisionally fixed some special standards including: manufacturing dimensions, limits of wear (finishing limits, working limits, maximum limits of wear), and has laid down some alterations of design for all wagon parts subject to wear. When getting out these standards (Werkgrenznormblätter) it was realised that in order to reduce the number of repairs and be able to do minor repairs more cheaply, it was important to fix the limits of wear of details of units, while taking into account the life of the materials used in making the parts in question, so that they should as far as possible wear down to the allowed limit at the same time.

2. — Czechoslovakia : State Railways.

The following parts of passenger coaches and goods wagons have been standardised: screws, plates, pins, rivets, pads, wood screws, nails, small rivets, rolled bars, paints, sawn timber, upholstery fabrics, etc.

Neither standardised dimensions nor limits of wear have yet been fixed for either new or worn parts.

3. — Rumania : State Railways.

Only a few passenger carriage parts have been standardised: axle boxes, brake blocks, and various rolled sections. In the case of goods wagons may be mentioned: draw gear, couplings, buffer spindles, cases and springs, axle boxes, and rolled sections.

Worn parts are not repaired and the

tolerances for small details or for repaired parts have not, therefore, been standardised.

4. — Switzerland : Federal Railways.

In the case of carriages and wagons, the following parts have been standardised:

1. Parts used in carriages and wagons: lamp brackets, screws, draw hooks, springs, screw couplings, buffers, wheels and axles, axle boxes, brake couplings, brake blocks, steam heating and electric couplings, plates;

2. Carriage parts: types, bogies, spring clips, ventilation, electric lighting and heating, vestibule diaphragms, vestibule gangways, windows;

3. Wagon details: types, axle guards, springs, sliding doors, floor boards, brakesman's look outs. Worn parts are not repaired and brought up to standard dimensions differing from those of new parts except in particular cases when some financial saving is certain.

As regards the wagons, the tolerances for new parts and repaired parts have only been standardised for the compressed air brake parts.

5. — Poland : State Railways.

As regards the standardisation of carriage and wagon details and the standardisation of tolerances for new parts and for repaired parts, the question is still under investigation.

6. — Bulgaria : State Railways and Harbours.

The carriages and wagons recently purchased have the same coupling and buffing gear; furthermore all similar parts are interchangeable.

Wagons are not yet repaired to standard dimensions, nor have standardised tolerances been introduced.

7. — Yugoslavia : State Railways.

The variety of types of vehicles has retarded the standardisation of both carriages and wagons.

8. — Sweden : Grängesberg-Oxelösund Railways.

No reply was sent to this question.

QUESTION No. 13. — Indicate the progress made in standardising building details and buildings as a whole.

Same question as regards the structures.

Same question as regards the permanent way.

Same question as regards the signals.

Have the tolerances been standardised for both new and repaired parts?

Replies.

1. — Germany : German State Railway Company.

Owing to the many local conditions and peculiarities which have usually to be taken into consideration definite standards have not yet been fixed in connection with the construction of the various buildings : as far as possible however, standardised constructional details (such as doors, windows, etc.) have been used.

The permanent way material of the Reichbahn has been standardised to a marked extent so that standard small parts are used in fastening the rails to metal or wood sleepers and in points and crossings.

In order to simplify and facilitate schemes relating to works, standard designs have been prepared (small metal bridges, platform roofs, etc.).

As regards steel bridge materials, special specifications have been drawn up.

The standardisation of signalling installations has been realised by the extended use of a single type of mechanical sig-

nalling and points operating mechanism, the different spare parts of which are made to existing standard drawings.

2. — Czechoslovakia : State Railways.

As regards works, the standardisation of the following buildings and installations has been carried through :

1. Locomotive sheds, stores, dormitories, block signal cabins, watchmen's shelters.

2. Weighbridges, turntables, inspection and ash pits.

The materials used in the permanent way are all standardised.

In order to simplify and speed up the work, standard designs have been drawn up.

3. — Rumania : State Railways.

Standard designs for special buildings such as locomotive sheds, water columns, and fuel oil columns, signal boxes, small passenger station buildings, etc., have been prepared.

At the same time, certain types of dwellings, dormitories, and baths for the staff have been built.

The standardisation and the reduction in the number of designs of permanent way materials have been followed up since the war without interruption and very satisfactory results have been obtained.

The standardisation of works and signalling installations is under examination at the present time.

4. — Switzerland : Federal Railways.

No remarks to make.

5. — Poland : State Railways.

Standardised parts are used in buildings. For buildings of no great importance, a series of standard designs has been prepared.

As regards the permanent way material, the sleepers, rails, and fastenings

have been standardised, and at the present time the standardisation of the points and crossings is in hand, this latter work being very difficult owing to the great varieties of styles of permanent way in Poland.

In the case of works, standard designs of metal, concrete and masonry bridges of from 2 to 20 m. (6 ft. 6 3/4 in. to 65 ft. 7 in.) spans for viaducts have been prepared.

All new signals are to standard designs.

6. — Bulgaria : State Railways and Harbours.

No remarks to make.

7. — Yugoslavia : State Railways.

Each of the old railway systems had standardised its buildings and operating plants. The present administration is taking steps to standardise first of all the permanent way and signalling equipment.

8. — Sweden : Grängesberg-Oxelösund Railways.

No reply to this question.

QUESTION NO. 14. — *Indicate the progress made in standardisation of office equipment, paper, files, etc.*

Give particulars of the advantages found in practice.

Same question as regards the various equipment used on a railway.

Replies.

1. — Germany : German State Railway Company.

The Reichbahn has progressively continued the standardisation of office materials (papers, files and other supplies and equipment) and this has made it possible to simplify gradually the supplies needed and at the same time to lighten appreciably the clerical work.

2. — Czechoslovakia : State Railways.

A standard size of paper has been introduced; the quality of paper, the printing and the binding have been standardised. This work is expected to show a saving of about 10 % on the stationary costs.

3. — Rumania : State Railways.

In the case of small office stores, there is no standard laid down, each official obtaining the materials found necessary and receiving an allowance therefore.

As regards the other supplies (printed forms, envelopes, etc.) their standardisation was decided upon recently.

The standardisation although but recently completed in conjunction with the standardisation of the stores service has given very good results as regards obtaining supplies, which has been simplified and made more easy, and the cost of materials is in consequence appreciably reduced.

4. — Switzerland : Federal Railways.

The stationary department has introduced as far as possible forms on the same size of paper, and this has made it possible to purchase standard office furniture and machines.

The Stores department has prepared a stock list of standard office supplies with the result that all services now receive the same articles.

Catalogues for the furniture and fittings already standardised have been prepared. These materials can consequently be bought in large quantities and therefore more cheaply.

5. — Poland : State Railways.

The standardisation of documents has made it possible to reduce the number from 1400 to about 1000 types. This reduction has reduced the costs as well as the stock to be held in store.

6. — **Bulgaria : State Railways and Harbours.**

No reply to the question.

7. — **Jugoslavia : State Railways.**

No reply.

8. — **Sweden : Grängesberg-Oxelösund Railways.**

The office materials and supplies for the whole system are issued by a special section of the headquarters office.

The equipment used is supplied by the stores.

PART II.

CHAPTER IV

Methods of attaching the staff to the Railway.

QUESTION 15. — *What are the general instructions regulating this part of the remuneration? Method of increasing this part of the remuneration with increased age. Conditions of promotion in the service. Are these conditions regulated by a staff agreement, by a shop agreement, or by conventions?*

Replies.

1. — **Germany : German State Railway Company.**

As regards salary, the employees of the Reichsbahn are divided into, *a*) employees on the staff (forming the major part ;

b) Employees not on the staff (including young employees who before they can be placed on the regular staff have to pass practical tests after having received preliminary instruction and successfully passed the respective examination);

c) Employees in preparatory training (including would-be employees who are trained for a definite branch of the service according to a given programme).

The current rate of pay of these classes of employee is laid down by the Reichsbahn in virtue of a regulation applicable on the basis of special arrangements.

a) The pay order provides for the employee on the staff (grouped into 17 categories divided into classes) a base salary in relation to the duty fulfilled. The number of places in each class of officials is decided according to the number of corresponding positions occupied. In the case of certain classes of employees, the number of whom, owing to the traffic falling off may diminish, a certain number of positions are not filled, the positions occupied being those corresponding with the minimum traffic, this number being the result of experience. In the event of the traffic becoming normal as well as when greater, the unoccupied positions are filled by learners, by staff in lower grades, or by employees not on the staff, on the same scales of pay.

In a given grade of pay, the base rates are attained gradually according to seniority, the increases in pay being automatic every two years, no special conditions being attached.

The promotion from one category to another, however, is not automatic, but only occurs when an employee is nominated to fill a given position in the higher grade (promotion by selection).

The right to a promotion of this kind is acquired either as the result of a special examination when a test of this kind is specified, or solely on a report giving particulars of the capabilities shown by the individual in the positions he has occupied.

The base rate of the salary is increased by the lodging allowance, the value of which varies according to the district (5 areas divided into 7 classes according to the base rate).

b) *Employees not on the regular staff* receive day rates which only represent

a part of the base rate of the regular staff and the lodging allowance which is the same as that allowed the regular staff.

c) *Employees under instruction* (learners) receive a rate of pay and a maintenance allowance which only represents a part of the pay of the respective employees who are not on the regular staff.

Note. — The salary of the employees has been reduced recently in two stages, once by 6 %, and the second time by 4 to 8 %.)

In the case of workmen the working conditions and pay conditions are regulated by a pay agreement (L.T.V.).

Derogations from the terms of this agreement, even if in favour of the workmen, are not allowed. The headquarters administration, however, can modify the regulations of the contract in favour of the workmen in the exceptional case in which it deals with groups of workmen. In this latter case an understanding must be concluded with the respective unions.

2. — Czechoslovakia : State Railways.

Any employee having worked a number of hours exceeding the legal working day of eight hours receives a supplementary allowance according to the work done.

In certain services the following premiums have been introduced :

a) for economies made in the materials used;

b) for economies in the operating through greater efficiency;

c) for having prevented damage to the plant, buildings, etc., of the railway.

The allowances not covered by the regulations consist of : a supplement for night work (from 10 p. m. to 6 a. m.) in case of continuous traffic working, divided into three classes, according to the importance, responsibility and difficulty of the work done;

an indemnity for service uniforms, purchase and repair included;

an allowance for additional work, the rate being calculated from the hourly rate increased by 25 %.

3. — Rumania : State Railways.

The staff of the Rumanian Railways is divided from a remuneration standpoint into three grades :

1. Clerical grades and staff on a fixed monthly salary;

2. Workmen paid by the hour or as agreed;

3. Auxiliary staff (various classes of workmen) taken on as required and paid by the day..

Increases in salary depend on promotion which is made in different ways according to the scales of pay mentioned above.

1) The promotion of the clerical grades and staff paid a fixed monthly salary is arranged in the following manner :

In the higher management positions (assistant general manager, managers, under-managers at headquarters and other posts of similar classes) the promotion is the result of designation based on suggestions from the general manager and approved by the administrative Council and the Ministry of Communications.

In the case of the middle grades (from the grade of chief clerk to that of head inspector) the promotion is always made by nomination on a recommendation of the promotion committee.

In the case of employment in grades immediately below the above, the promotion is on a mixed system, i. e. it is by selection and also by seniority, in the ratio of 2 to 1 respectively, always on the recommendation of the same promotion committee.

The promotion in the lower classes to

the above as well as the promotion of the men is solely by seniority.

All the classes of posts, however, require before promotion that the man has satisfied certain conditions of seniority (varying from 2 to 4 years) and completed certain courses of studies; there are also some classes of employees who have to undergo special tests.

2) The employees paid by the hour or by agreement can be promoted from one scale of pay to another according to seniority (3 to 4 years). All promotions are made within the limits of available positions, so that automatic promotion by length of service is not admitted. The conditions of promotion such as educational studies, obligatory courses of training, methods of advancement, (nomination, seniority), examination, etc., are laid down by law.

4. — Switzerland : Federal Railways.

The employees in the clerical grades in accordance with a legal agreement receive the salary corresponding to the scale rate on which they are put owing to the nature of their duties.

Each class has a minimum and a maximum. The initial salary corresponds, in principle, to the minimum rate applying to the position. Until the maximum is reached the employee has the right to receive an increase at the beginning of each year.

In the event of promotion, the employee has the right to an increase of salary, the rate varying according to fixed rates. The promotions are decided by the needs of the service. In principle, they can only be made within the limits laid down in the regulations and prescriptions. In the case of the higher posts, the special abilities of the officials are also taken into account.

As regards the conditions of remuneration of the workmen a distinction is made between the men employed in the repair shops who come under the legis-

lation governing work in factories, and who are paid by the hour, and the other workmen paid by the day (day workers).

The shopmen are grouped into different scales of pay, each with a minimum and a maximum. They have the right at the beginning of each year to an ordinary increase in pay.

In the event of promotion the workman receives an increase in pay. As regards the day workers, they are under a provisional legal agreement. Instructions are in course of preparation on a method of payment based on principles almost the same as those in force in the case of the shopmen, with the exception that they will continue to be paid by the day.

5. — Poland : State Railways.

All the staff of the Polish State Railways are grouped into grades. A list lays down the grades of the men who carry out each class of duties. A salary is fixed corresponding to each grade and increases automatically with seniority every three years, but cannot exceed a certain amount.

This increase in pay is suspended for the time being.

In the event of increased traffic or of heavy works temporary staff may be added to the regular staff over and above the limits laid down.

The pay of the temporary staff depends on the actual number of days worked. The staff with family charges, receive 75 % of their usual pay in the event of legitimate absence — illness, military service, etc.

The promotion of an employee depends upon his ability, and he has passed an examination if the regulations so require.

All conditions relating to the pay of the staff are regulated by a Government decree.

6. — Bulgaria : State Railways and Harbours.

The employees are divided into 6 classes by law and their pay is fixed by the national budget. The promotion in the service is as needed to fill vacant places, promotion to certain posts involving the passing of special examinations.

7. — Yugoslavia : State Railways.

No reply has been given to this question.

8. — Sweden : Grängesberg-Oxelösund Railways.

The pay is increased every three years, depending on the seniority of the men. As regards promotion, the age and seniority govern this in the case of candidates of equal merit and who have passed the same examinations. The conditions governing promotion are regulated by agreements between the staff and the administration. All posts becoming vacant are open to competition.

The ordinary staff is bound to the railway by individual contracts.

QUESTION NO. 16. — Do you grant allowances which take into account the family of the employee and the cost of living at this place of residence?

Do you grant the employees travelling facilities for journeys other than on service and are these facilities extended to their families and to what extent?

What holidays with pay are granted to the employees?

What are the general conditions of the retiring pensions granted to employees? Are these pensions built up by contributions held back from the employee's pay with contributions from the railway? Proportion of contributions by the employees and by the railway?

What is the amount of the pension relatively to the pay? How does it vary with the age of the beneficiary and his years of service? How is the employee

leaving the railway before fulfilment of the conditions entitling him to pension dealt with?

Briefly show how the pension is calculated from the different factors taken into consideration.

State if there has been any adjustment of pensions already granted in the event of the pay of the employees in active service being altered?

Indicate the general organisation of your medical service and give particulars especially as regards the following :

Under what conditions are medical care, pharmaceutical supplies, dental care, etc., provided for the employees? Is it gratuitous or at their charge, or according to a combination of the two methods and if so on what basis? Are or are not the medical services given by the railway extended to the families and under what conditions? What is done in the event of illness involving the employee being sent to hospital, as for example an open air cure at a sanatorium?

Does the railway take any action, and under what conditions, when a member of a man's family has to be sent to hospital?

What is the practice on your railway as regards the application of punishment in the case of misbehaviour?

Indicate if the procedure provides for the intervention of staff delegates, and if so under what conditions?

Replies.

1. — Germany : German State Railway Company.

The family and the cost of living at the place of residence of the employee are taken into consideration by providing, over and above the base rate of pay, lodging allowances, family allowances, and other special grants varying according to the locality. The premiums are the same for all classes of employees and for all areas and increase propor-

tionally with the number of children. These premiums are payable until the children reach the age of 17 years, and even after if the child is continuing its studies at school or is unable to earn its living.

The special cost of living allowances are granted in localities where the cost of living is excessively high, and are granted to the regular staff as to those employees not on the staff.

The workmen receive equal allowances for each child (in accordance with the contract of rates L.T.V.). The difference in local conditions is also taken into account in the case of workmen in the sense that their pay also varies according to the areas and localities.

Each employee or workman has the right to use the railway without charge when changing his place of residence, to go to work, to attend courses of study, when receiving medical assistance, to purchase food supplies, and for private business. The number of free journeys for private business purposes may not exceed 10 during the year.

The members of the employee's or workman's family are also granted free travelling for some of the reasons given above and a single journey annually for any other good reason.

The employees are granted an annual period of leave with pay, the length of the period being fixed according to instructions from the General Manager.

The length of the period may be from 4 to 42 days per annum, depending in the case of :

- *regular staff* : on age and position,
- *employees not on the staff and learners* : on the service reports in addition to age and position.

Special leave (up to 3 days a year) with pay is granted in addition under certain conditions (such as death in the family).

The staff working on contract (An-

gestellten) are granted leave on the same conditions as the employees.

The workmen are granted leave with pay in accordance with the pay regulations.

The pensions scheme differs according to the grades of staff.

A. — *Employees*. — The right to pension of the employees or — in case of death the right of their descendents — to assistance is acquired after 10 years' service. In exceptional cases the employees who become unfit for service before the end of 10 years can be granted pension without however this provision conferring on them any right thereto.

The rights to pension are guaranteed by special laws.

The funds reserved for pensions are built up partly by contributions from the staff, and partly by grants from the administration. The pension represents a part of the salary received, 35 to 80 % of the total salary, according to the number of years' service.

Employees who resign of their own free will from the service, although still fit for duty, receive no pension.

As regards employees discharged and for whom no pension is provided, the administration has to pay for all the years of service contributions to the state employment assurance of the staff working on contract (Angestelltenversicherung) and to the sickness insurance (Invalidenversicherung).

The allocation of the pension is made on the following lines : after 10 years' service the pension represents 25 % of the respective pay; at the end of 25 years' service it increases by 2 %, and after 25 years by only 1 %, without however ever exceeding 80 % (this maximum figure has since been reduced to 75 %).

In the case of widows, the pension represents 60 % of the pension to which the husband would have been entitled;

for each child it is $\frac{1}{5}$ of the sum its widowed mother receives, while alive, and $\frac{1}{3}$ after her death.

Alteration in the pay of employees in service involves alteration in the pension and subsidies paid to the employees already retired.

B. — *Staff working on contract.* — The assistance granted to this class of employee to meet their old age needs is awarded to them by means of insurances.

The old age insurance of these men (and of the workmen) is fixed by a special insurance law in which provision is made for old age and for the incapacity of the insured for work, as for the assistance to be given to his descendants.

The employees are assured in the State Insurance Fund (Reichsversicherungsanstalt), the insurance being obligatory for all employees receiving a salary of less than 8 400 Rm. annually.

The payment of the contributions to the insurance fund is made in equal parts by the insured and by the Reichsbahn.

As regards the insurance premiums the staff on contract are placed in several classes according to the amount of their pay, the payment of these premiums being made when they are paid their wages, by sticking on insurance stamps corresponding to the grade of the insured, in the insurance book of the latter and by deducting half the value of the stamp from his pay, the administration having to find the other half.

The subscription to the insurance fund guarantees to the employee a pension either when he reaches the age of 65 years, or in case of incapacity, and at the same time assures to his family (widow unable to work and orphans) means of existence after his death.

In addition to this State insurance, an agreement has been come to between the Government and the professional asso-

ciations of the employees under contract, which the Reichsbahn has accepted with the object of effecting an additional insurance under the form of an additional allowance above the regulation amount.

The question has been solved by allowing the employee after his fifth month in the service to insure in a higher grade than that laid down by law.

C. — *Workmen.* — Under the State insurance law's regulations, the workmen have to be insured both to make provision against sickness and old age, and to provide for their descendants. All these insurances are effected under the control of the Reichsbahn by four pension funds (Reichsbahnarbeiterpensionskassen).

All workmen are required to insure themselves against sickness from their entry into the service until they leave it. From this moment the insured is free to continue his contribution or not.

The insurance contributions are equally shared between the workmen (divided into 7 classes according to pay) and the Reichsbahn, the amount of the pension granted depending on the total contributions paid.

On the basis of the insurances against sickness, the following allowances are granted :

a) sickness, old age and permanent incapacity allowances (on account of which the insured must have paid at least 200 weekly contributions);

b) widows' allowances;

c) orphans' allowance, to legitimate children of the insured, payable until their 15th year and beyond if they are incapable of earning their own living;

d) medical assistance in hospitals and in sanatoriums as a precaution against sickness (the pension fund has sanatoriums for tubercular cases, homes for invalids, hospitals for children, etc).

In addition to the means of assistance

quoted above the insured workman receives supplementary allowances from a special assistance fund (Zusatzkasse) as well as grants in the event of death.

The workmen are obliged to belong to this insurance fund.

Example :

Mean annual pension for a retired workman . .	523.80 Rm.
Mean supplementary allow- ance	507.89 Rm.
Total . . .	1 031.69 Rm.

Alteration in pay does not result in alterations in the rates of retirement pensions nor in the pensions granted to their descendents, because the annual amount of the pension is based on the total contributions paid. These pensions may however undergo modification as the results of decisions of the managing committee of the pensions fund on which the workmen's corporations are represented.

General organisation of the medical service. — The headquarters administration has attached to it a chief medical officer to deal with all medical matters affecting the service (Reichsbahnoberbahnarzt). In the same way for consultations and to get authoritative advice on matters affecting eyesight (especially relating to the distinguishing of colours), there is an oculist at general headquarters.

A doctor (Oberbahnarzt) is attached to each area headquarters, this appointment having to be approved by the representatives of the employees.

In the areas controlled by each area management there are a certain number of doctors, according to needs, who, besides looking after the staff, attend to employees in the outdoors service, when ill. Besides such doctors there are also eye and ear specialists; the other posts for specialists supported by the Reichsbahn up to the present time will have to be abolished in the near future.

The medical service of the Reichsbahn is organised first of all to make the working safe and only gives medical assistance as a secondary matter. For this reason the outdoors employees can only profit by treatment within certain limits whilst it is refused altogether to employees at headquarters and their families.

Only in the case of the campaign against tuberculosis have more general measures been taken by placing sanatoriums at the disposal of the men and their families, outdoor employees also being admitted for treatment.

Staff insurance in case of sickness. — In order to help such employees, the Reichsbahn in 1926 set up the sickness insurance fund.

The employees as well as part of those on contract have the right to insurance with the institution against sickness by paying certain contributions; the administration also contributes.

This insurance fund grants according to a given tariff to the members and their families assistance towards medical treatment, medicines, etc., as well as a weekly money allowance and a grant in case of death. The managing committee is represented by members whose duty is to solve all appeals against the decisions of the insurance fund.

The insurance against sickness for staff working under contract and the ordinary workmen as required by law, is dealt with by the 27 sickness insurance offices of the operating department (Betriebskrankenkassen), controlled by the Reichsbahn and to which belong as members, without exception, all workmen and staff on contract, from the time of entering the service until leaving it.

These insurance funds grant :

- a) help in case of sickness;
- b) weekly allowances;
- c) help in case of death;
- d) family allowances.

a) Help in case of sickness consists of free medical treatment, medicines and dressings, reduction in prices of medicines, all this help being granted the patients for 52 weeks' illness.

In addition monetary assistance (according to salary) is granted from the 4th day after stopping work and continued to the limit of 52 weeks.

Instead of the assistance given above, the treatment can be given in hospitals and the assured person with a family may ask for monetary subsidies to support his family up to as much as half the sums provided for the hospital treatment.

b) Weekly assistance is granted to members in the case of child birth, the members receiving medicines, medical attention, as well as an allowance in money for 4 weeks before the birth and 6 weeks after.

c) The assistance in case of death granted to the family on the death of the insured consists in the payment of a sum of 20 to 40 times the basic rate, but in the event of the death of a member of the family under the charge of the insured, the allowance is only a part of this sum.

d) The insured person with a family who in the last 6 months has been insured during 3 months at least, receives advances from his account in the event of his wife or children being ill, in value equal to that to which he would be entitled.

The funds for the insurances against sickness are found jointly by the contributions of the Reichsbahn (1/3), and by those of the men (2/3), which amounts in the form of percentages calculated by each fund are deducted from the pay of the latter, so that the receipts may cover the payments.

The managing committee and the administrative council of these insurance funds are composed of a representative of the Reichsbahn and representatives of the workmen.

2. — Czechoslovakia : State Railways.

An educational allowance for one or two children, supplementary allowance for three to six children, as well as a lodging allowance varying with the class of service and the place of residence, are granted to the men. Twelve free journeys are allowed to the men each year. The wife and children of the man have a right to 3 free passes, and to travel at reduced rates without limits; the relations and servants supported by the staff can travel at service rates. Free travel is also granted to the children of the men to enable them to travel to school or to work at their trade.

The men are also given leave with pay on request, the period of the leave varying according to the position in the service; sick leave with pay is also given.

The management has set up for the workmen and employees a special organisation which makes grants at least equal to those fixed by the social insurance laws.

As regards the amount of the retirement pension, a distinction is made between men permanently attached to the administration, and those whose connection is temporary.

The retirement pensions vary according to the class of service of the men and the number of years of service. In case of death the widow and children enjoy corresponding rights.

If the man retires from the service without having filled the conditions laid down for pension, he loses the right thereto; if he takes service elsewhere his rights are transferred; if he is removed from duty through police conviction or for disciplinary reasons, allowances are made to his innocent family in cases worthy of notice during the time he is absent.

Organisation of the medical service.

— Medical questions are managed by the department of the medical services of the Ministry of Railways, by medical

groups at the area managements, and by the railway doctors, who are employed under contract and distributed over all the system which is divided into 796 medical districts.

All the men on the active list, temporary and permanent, all men on retirement, and, if they wish it, those receiving pensions and grants, have to be members of the sickness fund of the State Railways.

Medical attention is given generally, based on the sickness insurance scheme and at the charge of the insurance fund.

The contribution of the insured is 1 % of their salary or of their pension, and in case of men paid by the day, 3.8 % of their pay is taken.

The insured, including members of their family, have the right to :

- a) medical treatment (consultations or visits);
- b) medicaments.

As measures of social aid, the following organisations have been set up :

- a) The assistance fund of the sickness insurance fund, which is applied to all cases in which the fund itself, owing to the rules, is not able to take action;
- b) The special social fund, supported by the voluntary contributions of the men (various loans, etc., may be granted to the employees);
- c) The funds intended to assist the consumptive members of the staff to get sanatorium treatment, etc..

Punishments for misbehaviour are imposed on the temporary staff according to the prescriptions in the work regulations, and on the permanent staff, according to the stipulations of the service regulations applying to the staff of the Czechoslovakian State Railways. The first receive a caution or a fine and, in serious cases, can be discharged immediately.

Before a punishment takes effect, the

man is given an opportunity to justify himself (he has the right to appeal to the railway management within 15 days).

In the case of the permanent staff the punishment depends upon the gravity of the fault. The punishments may be :

- a) A simple remonstrance accompanied by a warning;
- b) A written admonition;
- c) Fines;
- d) Transfer to other duties, either in the same grade or an inferior one;
- e) Reduction of pay;
- f) Being retired with reduction of pay; and
- g) Dismissal.

The punishments cannot be cancelled.

The disciplinary punishments b) to e) involve the loss of the right to promotion.

The penal disciplinary jurisdiction is in the hands of two disciplinary bodies (1st instance : the disciplinary senate — and 2nd instance : the disciplinary corps). Against the sentence passed by the disciplinary senate, the accused can appeal within 15 days.

The disciplinary corps attached to the Ministry decides especially on those matters the decisions on which do not involve a fresh enquiry (appeal against sentences, etc.).

The president of the management of the State Railways, as well as the Minister have the special privilege of reducing a sentence.

Besides the appeal, provision is made for measures such as the re-opening of the disciplinary procedure and the extension of the period within which the appeal must be lodged.

The committees of staff delegates cannot interfere in disciplinary measures affecting the employees except in the case in which the delegate is being dealt with for opinions expressed in carrying out his functions.

3. — Rumania : State Railways.

The salary of the staff of the Rumanian Railways is made up of :

a) the base salary fixed by the table of pay;

b) the cost of living bonus, and

c) the lodging allowance.

b) The cost of living bonus is divided into 4 classes according to the areas.

c) The lodging allowances represent 20 % of the base pay for bachelors, 25 % for married men and 30 % for married men or widows with children under age.

Leave. — The employees and men are allowed as far as the requirements of the service allow ordinary leave or special leave requested for personal matters.

These leaves take into account the years of service and vary from 10 to 30 days per annum.

Leave obtained (only on the advice of the medical service) to take a cure at health or climatic resorts can also be included in ordinary leave. Such leave is for 30 days at most and includes the payment of the salary. In such a case the amount of ordinary leave and leave for personal matters is reduced by half.

Leave in case of illness. — Leave in case of illness is granted on the advice of the medical service. Such leave is extended up to 12 months, the first six months being at full pay and the next at half pay.

If the man or employee is not able to resume duty at the expiration of this leave, he can (if he has had 10 years' service) benefit by his right to retire and receive a pension. If he has no such right he is paid off and given a grant (varying with the years of service and also in the event of the employee removed from service being tubercular) from the general pension fund.

The Rumanian Railways grant a limited number of free passes to their staff

and employees (6 per year) and half this number to their wives and children under age.

They also grant a limited number of passes with reduction of 75 % on the rates.

The pensions scheme varies with the category and class of the staff.

A. — Employees (staff in the general pension fund). — The conditions of the pensions scheme applicable to this class of employee is laid down in the general pensions law. The pensions are granted in the following cases :

1) When the conditions of length of service or the age limit are satisfied. The age limit is 60 years; it is extended in the case of the doctors and engineers to 66 years according to their grade. If an employee is 57 years old and has 35 years' service he can if he so wishes claim his right to retire under pension.

The period of service can be reduced to 25 years for the locomotive staff and in special cases (affecting employees who took part in the war and certain classes of operating staff) it can be reduced to 30 years.

These limits have undergone certain slight modifications, having been somewhat reduced in 1930 and 1931, in order to reduce the strength of the establishment, the age limit having been fixed at 57 years and the period of service at 30 years.

After 10 years service the pensioner is granted an amount of on the average 35 % of the base salaries of the last three years, the increase provided for being 3 % per annum up to 35 years.

The drivers in the locomotive service, with 25 years service, are the only exceptions to this rule and they receive the full average amount.

2) *Pensions for infirmities.* — In the event of an infirmity arising in service but not due to the service, rendering the employee unsuitable for any public

employment, he is granted a pension, the base value of which is 40 % increased by 3 % for each completed year in excess of 10 years service. In case of total incapacity, a supplement of 10 % is added to the amounts as determined above, the minimum pension being not less than 75 % calculated on the last rate of pay.

In the event of total incapacity, due to an accident whilst at work, the pension laid down equals the last base rate of pay.

3) Pensions granted to descendants. — The widows of employees receive a proportion of their husband's pension, this varying from 25 to 70 % according to the number of years lived together.

The children receive pensions according to their number; for one child it is 20 %, for two 35 % and so on.

As regards orphans, these amounts are increased to 50 % in the case of one child, to 75 % of two, and to 100 % for three or more.

The widow on re-marriage has no right to a pension unless she has lived with her husband, retired through infirmity, for at least 10 years.

4) Assistance given for funerals. — The descendants of a deceased employee are given a grant to meet the expenses of burial equivalent to three months pay increased by all the allowances he drew. The same principle is followed in the case of pensioned staff.

B. — *Employees and workmen (members of the assistance fund).*

1) Length of service pension. — The right to pension of the employees and workmen members of the assistance fund is acquired after 35 years' service (counted from reaching his majority) on condition of being not less than 57 years of age.

Some classes of operating staff and workmen are granted an extra allowance

resulting from the number of years of service with a corresponding reduction in the age limit.

The pension of employees and workmen is calculated relatively to the base pay of the employees and after a fixed number of working hours in the case of the workmen, with the difference that in the case of this category of pensioners, the cost of living bonus no longer varies with the district: it is the same in all cases and less than that allowed by the pension fund.

The initial base pension is 30 % of the average pay during the last two years; it is increased by 3 % for each year of service up to 25 years and 2.5 % afterwards up to the limit of 35 years.

2) Infirmity pension. — In the case of accident while at work followed by total incapacity, the victim is given a pension equal to the the pay received at the moment the accident occurred, and in the case of partial incapacity, the pension is calculated according to the years of service, increased by 10 years.

3) Pensions for descendants. — The widow receives 50 % of the pension of the deceased husband independently of the number of years they lived together, and the children receive a pension of from 20 % to 50 % depending on the number and during the life of their mother. If the mother loses her right to pension or dies, the pension of the children is calculated in the same way but starts at 50 % and increases up to the full pension being paid.

4) Special grants in case of death and birth, etc. — The grants given to meet the cost of interment of the wife or child of an employee or workmen who is in the assistance fund, equals twice and once respectively the amount of the monthly salaries.

On the occasion of a birth, in addition to the medical care, a subsidy of 500 lei is granted.

— Participation in the pension fund. — The employees and staff (in the pension fund and the assistance fund) are obliged to share in building up their pension, 10 % and 5 % respectively being deducted from their total salary, whilst the administration contributes 5 % on the total amount of its budget plus another amount fixed annually.

— Pension alterations. — The pensions once determined become definite and cannot be increased. In the case of an employee retired on account of ill-health recovering and resuming work, on final retirement the pension has to be calculated again as it is necessary to take into account the time served before he again returned to duty.

The increase or reduction of pay of employees in service does not involve as of right, but does in fact cause an alteration in the pension of the retired staff.

— The organisation of the medical service includes :

1. A service directly under general headquarters known as the medical headquarters with the aim of supervising and controlling the activities of the doctors in the medical areas of the system.

These doctors besides the medical inspection of the staff for reasons of operating safety, attend to the staff and to a certain extent to members of their families.

2. A self-contained institution with its managing council on which the railway is represented, known as the « Rumanian Railways Staff Protection and Assistance Fund », the medical assistance work of which in favour of the men and their families is provided from a tax on passenger tickets.

This medical assistance is carried out through polyclinics established for the purpose.

In the case of illness requiring open air and sanatorium treatment, the Ad-

ministration helps by granting medical leave and monetary assistance.

— Punishment. — Any infraction or irregularity reported or discovered committed by an employee is followed by an enquiry either by someone of a higher grade than the accused, or by a committee nominated for the purpose.

In the case of misbehaviour being proved one of the disciplinary punishments, varying from verbal admonitions to reduction in grade, is awarded.

The most severe punishments such as discharge, suspension and reduction are awarded by the general management on the advice of the disciplinary commission or the commissions passing judgment on accidents.

The Commissions passing judgment on accidents, composed of departmental officers, give their opinions on the responsibility of the staff in the case of railway accidents basing them solely on the documents drawn up by the commission of enquiry and without calling the incriminated person before them.

Besides the disciplinary punishments mentioned above the person proved responsible for accidents can be made to pay within certain limits compensation to the Administration.

— The disciplinary commission deal with infractions and abuses (outside accidents) liable to more severe punishments.

The trial of the case has to conform to certain rules, namely : the accusation has to be made by an employee delegated by the management and the defence by the accused in person assisted by a colleague.

The sentences of the disciplinary commission duly approved are final and are carried out without appeal.

During the preliminary enquiries prior to the case being dealt with, the employee may be suspended.

In the event of public action against an employee for having committed crimes or violated the law in a way punish-

able by law, the suspension of the said employee is obligatory and is followed, if he be acquitted, by the legal authorities, by a subsequent decision of the railway disciplinary commission. In the event of a definite condemnation by the legal authorities, the employee is removed from the railway service.

Such discharged employees can never again occupy any public position. The delegates of the staff are not allowed to intervene in any way in these disciplinary matters.

4. — Switzerland : Federal Railways.

In localities where the cost of living exceeds the average, the employees receive a special allowance known as the residential allowance and which varies with the civil position of the employee. The only family allowance is that for each child under 18 years of age and not engaged in any paid occupation.

The staff are given travelling facilities consisting of free tickets and reduced rate tickets. The number of free tickets issued varies according to the position held and they are issued to employees, apprentices, crossing keepers and permanent workmen. The families of the men and the temporary workmen receive a fixed number of free tickets : three and two free tickets respectively each year.

The clerical employees have a right to reduced rate tickets as soon as they enter the service, the other employees only after 6 months service, which favour is also granted to their families.

The operating staff are entitled to annual leave with pay, the length depending on the number of years of service and the man's age.

The administrative staff also are allowed leave, the length varying according to the length of service, age, the scale of pay, and the position of the employee. The length of leave of the repair shop staff also varies with the

years of service and the age of the workmen — 16 1/2 days at the most.

All the staff is insured against sickness, infirmity, old age, discharge (not due to any fault of the insured) as well as in case of death by the granting of pensions built up by deductions from the pay and with contributions from the administration. The men are also obliged to pay in a contribution equal to 4 or 5 months' pay (including all increases granted them), the Administration on its side making a contribution equal to 5 months' pay.

The pension varies with the salary and the years of service of the man, the total of the pension not being allowed to exceed 75 %. The employee who leaves the service without having fulfilled the required conditions of the pensions regulations is paid back all his contributions without interest.

The medical service of the Federal Railways is part of a special service under the General Management and is directed by a chief medical officer assisted by three other doctors. Other doctors known as « Médecins de confiance » not solely employed by the railway and appointed all over the whole system have as their main duty to look after the staff when ill or hurt through accident, and to examine the staff from a health point of view.

The Federal Railways have not made arrangements for gratuitous medical attention, nor medicaments, these having to be arranged by the staff itself. The staff have however the opportunity of insuring themselves in the « Federal Railways Staff Sickness Assurance Fund » which provides, when needed, medical care and medicines. The administration does not grant any regular contribution : it only meets the management expenses and if need be bears half any working deficit. The medical service and the « Assurance Fund » only affects the men and not their families.

The Administration does not meet

hospital charges for sick employees : the assurance fund meets such expenses as far as its regulations allow. In special cases of indigence or distress due to illness the pension and aid fund is authorised to help the men by granting allowances from the funds provided for this purpose. When a member of the family of an employee has to be sent to hospital and the employee is not able to meet the cost, the pensions and aid fund will grant him a sum of money taken from a fund available for this purpose.

The disciplinary procedure for applying punishment is controlled by different arrangements. The disciplinary punishments are : 1) caution; 2) fines up to 100 fr.; 3) withdrawal of travelling facilities; 4) temporary suspension of the employee with reduction or stoppage of pay; 5) disciplinary change of occupation or reduction; 6) reduction in pay; 7 reduction of pay or stoppage of ordinary additions to the pay; 8) placed on the spare list temporarily, and 9) discharge.

The disciplinary punishments can only be applied after an enquiry has been held. The employee who has been given disciplinary punishment can appeal against it to the management if the punishment comes under one of the headings 1) to 7) above. The authority dealing with the appeal, if it judges it desirable, orders a further enquiry and sends the papers to the disciplinary commission, composed of a president, not belonging to the administration and two members, one elected by the staff. The disciplinary commission has a consultative role only, the appeal authority being the only one which decides the appeal and conveys its decision to the appellant with the reasons determining it.

The appeal against the last two punishments under headings 8) and 9) is subject to the jurisdiction of the Court of Litigation for civil servants of the Federal tribunal.

5. — Poland : State Railways.

The employee with a family is given a supplement of pay (which is the same for all the staff), for his wife and for each child, four at most.

Each man, if lodging accommodation is not provided, receives an allowance varying with his grade, his private position and the locality.

Each man and the members of his family (in the case of children up to their majority) receives three free tickets each year and an unrestricted number of tickets at reduced rates (20% of the ordinary rate).

The staff are granted leave with pay, the length increasing with the years of service; for the clerical staff this leave is at least 14 days, and 35 days at most, and for the workmen 8 and 15 days respectively.

Every man has the right, after a certain time in the service, to a retiring pension which, in case of death, is payable in a certain proportion to his widow and children under age.

The deductions are 6 % for all the ordinary staff and 9 % for the train staff, and are taken off the fixed pay and on the lodging allowance of unmarried men. The contribution of the Administration is shown in the budget under the expenditures.

The amount of the retiring pension for the regular staff, after 10 years' service, is 40 % and can amount to 100 % after 35 years' service, the pension being based on the fixed pay plus the lodging allowance. To the amount so obtained the family allowance which remains unchanged is added. For men not on the staff the pension is 50 % after 15 years' service with an annual increase of 2.5 % up to 100 % of the base rate of pay. For the men in the running department, the actual period of service is multiplied by 1.5.

When leaving the service the employee obtains his retiring pension provided he

has fulfilled certain conditions, as regards age limit and length of service, or if he has been obliged to resign for any other reason (physical or mental defects, accidents whilst at work, etc.), excluding disciplinary punishments or if he has resigned before he has had 10 years' service; in this last event he loses his right to pension and the deductions from his pay are not returned to him.

Each area management is divided into health sections, each under a chief doctor with several doctors and dentists, and the necessary staff. The doctors usually see the sick in the railway clinics and in specially provided consulting rooms; the doctor in cases of severe illness are obliged to attend the patient at his home.

The employees and their families, the pensioners but not their families have, the right to consult the doctors free of charge; medicaments are supplied at reduced prices, 25 %, the remainder being paid by the administration.

As regards sending sick staff, whether in service or on pension, to sanatoriums, mental homes and to spas, the men pay reduced rates, the balance being paid by the Administration. In the case of fresh air cures, allowances are granted.

The wife and children under age of men in active service also benefit by hospital treatment at reduced rates.

In case of confinement, a woman employed by the railway like the wife of an employee receives medical care as well as special allowances.

As regards punishments, a distinction is made between the punishments of « order » in the case of simple fault, which are applied by the immediately higher authority and the disciplinary punishments in the case of serious delinquencies, which are applied by the headquarters disciplinary commission or by the higher disciplinary commission.

The former is composed of a president, two substitutes, 12 nominated members, 100 members and 50 substitutes

drawn by lot from the men of the different services, the full meeting being completed by the president, a nominated member and one member drawn by lot belonging to the same service as the accused.

The employee can appeal against the decision of this commission to the higher disciplinary commission which is an organisation in the Ministry of Communications and composed of higher officials and whose decision is final.

6. — Bulgaria : State Railways and Harbours.

The supplementary allowances introduced during the world war have been suppressed. The difference in the cost of living in the different places of residence does not give rise to additional allowances.

As regards travelling facilities, the administration gives 4 free tickets to the employees and 3 to their families yearly. The leave with pay is 30 days per annum.

The retiring conditions of the State employees are regulated by a special law.

The deduction for pension represents 10 % of the pay, the state contribution 5 %. The maximum amount of the pension is 80 % of the average salary of the six last years of service. The employee leaving the service before the period of 25 years laid down and not having reached the age of 48 years has no right to any retiring pension.

There is a disciplinary council at the general headquarters in which each department has its representative elected by the respective employees. The other members of the council are nominated by the Minister.

The disciplinary council deals with the staff for service faults by inflicting punishments subject to the approval of the Minister.

7. — Yugoslavia : State Railways.

The health department includes the administrative and health service and the medical service.

The administrative and health service is part of the management of the system whereas the medical service is under the management of the «Sickness and Aid Fund». Medical attention and medicaments are supplied free of charge. Medical attention is also extended to the families of employees.

Free hospital treatment in the case of sickness is given to all employees whether in active service or retired, as well as to the members of their families.

The management of the «Sickness and Aid Fund» is self-contained, the managing committee being formed by representatives of the railway administration and of the staff.

Disciplinary matters are dealt with by councils set up in each department.

8. — Sweden : Grängesberg-Oxelösund Railways.

Allowances to meet the cost of living at the place of residence are granted.

The administration allows its married staff 18 free tickets each quarter, the family being allowed to use 12; the unmarried staff are allowed 6 free tickets per quarter.

The ordinary staff is given leave with pay of 15 to 30 days each year, according to length of service.

The pensions are built up from deductions from the pay, the deductions varying from 7 to 14 % according to the age and the amount of pay, and by contributions of the railway which are equal to the amount contributed by the employees increased by 10 %.

The maximum pension is 70 % of the fixed pay and varies between this maximum and 40 % according to age.

Any employee leaving the service before completing the pensions conditions,

only receives the refund of 75 % of his contributions.

Medical attention and medicaments are supplied free of charge to the ordinary staff, and to their families, except that in the case of the latter, medicines are not supplied free of charge.

The cases of misbehaviour committed by the employees are disposed of by their chiefs, the staff delegates not being allowed to intervene.

QUESTION No. 17. — *Improvements in the working conditions.*

Indicate the steps taken in a general way to protect the personnel from accident.

Indicate the steps taken to assist the victim or the families in the event of accident.

Have you any organisation for supervising and improving the hygienic conditions of the premises used by the staff (especially as regards ventilation, lighting, the provision of wash-basins, etc.).

Has your railway built and placed at the disposal of the train staff: dormitories, mess-rooms, and other conveniences, such as shower baths, for the use of the drivers, firemen and guards when away from home?

Replies.

1. — Germany : German State Railway Company.

With the object of protecting the staff against accidents the following steps have been taken :

a) Distribution of instructions on how to avoid accidents, which are available for all the men;

b) Fitting guards to the machines and to the tools;

c) Supervision of the whole of the staff, which is required to obey the instructions laid down on how to avoid accidents, a supervision exercised over each service, shop, etc., by an employee appointed for the purpose;

d) The wide use at all places frequent-
ed by the staff of posters completing the
instructions against accidents;

e) Explanations and verbal exhorta-
tions by the head of the service, either
directly, or by lectures given to the staff;

f) Collaboration of the staff, which on
its part is expected to make the safety
precautions laid down to prevent acci-
dents more efficacious. (Rewards are
even given to the men who suggest meas-
ures or devise arrangements which
might be used successfully);

g) Careful selection of the staff, the
doctors being required to be extremely
difficult when deciding if the physical
requirements laid down for the men are
satisfied. In addition to these condi-
tions, admission to certain classes of the
staff is entirely based on the results of
a psycho-technical examination.

Moreover, as each accident is reported
in the service table, the men against
whom there exists the presumption of
not knowing how to avoid repeated ac-
cidents, are withdrawn from the parti-
cularly exposed positions.

All these measures have given excel-
lent results, the number of accidents
during the last years becoming smaller
and smaller.

In order to reduce to a minimum any
danger to which the staff is exposed,
much attention is being given to the
improvement of the safety methods and
to completing by further instructions
the steps taken to prevent the repetition
of accidents. The employees are assured
against the consequences of accidents
occurring during work, in accordance
with the terms of the 1901 law, while
the workmen in this respect are under
the insurance regulations of the Reich.

On the basis of the prescriptions of
these laws, the victim of the accident is
entitled first of all to the medical care
his condition requires, and to monetary
assistance in the event of illness.

If the man who has suffered an acci-

dent finds himself as a result unable to
provide in a normal manner for the con-
ditions of existence, he is given a pen-
sion the amount of which is based both
on the value of the salary received dur-
ing the last years and also on the extent
to which he is incapacitated from follow-
ing his work.

In the case of seriously injured men,
an additional allowance in favour of his
children is granted, and in case of death,
the descendants are granted subsidies in
the case of death, and a pension.

In addition to the compensation grant-
ed in case of accident or as a result of
illness, contracted in the service, the
Reichsbahn has provided for such me-
dical treatment to be given as will
enable the patient to recover, altogether
or partially, the working capacity re-
duced through the accident.

Consequently, if necessary, an artifi-
cial limb is provided, or the invalid is
trained for some other occupation, also
being given the necessary assistance in
finding new employment.

As regards the annual amount of com-
pensation payable to the victim of an
accident or his descendants, the payment
is carried out in accordance with the
following regulations: in the case of total
incapacity for work, the victim of the
accident receives a pension to 2/3rds
of his annual earnings, and in the case
of partial incapacity a part only of these
earnings, based on the proportion by
which his capacity is reduced.

In the event of death, the widow re-
ceives an allowance representing 1/5th
of the annual salary her husband re-
ceived; if the widow also is unable to
work to more than 1/2 capacity, she
receives an allowance equal to 2/5ths
of the pay, and in the event of re-
marriage a total indemnity of 3/5ths of
the salary of the deceased, payable for
one year alone.

For each orphan the pension repre-
sents 1/5th of the annual salary of their
deceased father, this being generally

paid up to the age of 15 years, and beyond this age if attending courses of studies up to 21 years of age (at which age he is considered as having completed his studies).

The pension of the employee's parents represents in total 1/5th of the annual salary of the deceased.

The whole of the compensations enumerated above are borne by the Reichsbahn.

As regards the supervision and improvement of the hygienic conditions in the buildings used by the staff, the heads of departments under whom the buildings in question are placed are primarily responsible; the duty of periodically inspecting these buildings as well as making proposals for their improvement belongs to the medical service of the Reichsbahn.

The train staffs, when away from home, have at their disposal in the marshalling yards and stations where they are relieved, waiting rooms and dormitories provided with all the necessary washing equipment (baths, shower-baths, etc.), as well as cooking facilities, etc.

In addition, in the stations, workshops, depots, etc., there are specially equipped rooms for use as mess rooms, in which the men when off duty can take their meals or rest.

For the use of the men engaged on permanent way repair work, who have to be away from home frequently to meet the requirements of the service, camps are erected and braziers provided for warmth; as for the travelling construction gangs (Baukolonnen), wagons and trains are provided as living accommodation (Cfr. report to the International Railway Congress of Madrid 1930, *Bulletin* for March 1930, p. 1127).

In the case of large works, canteens, baths, etc., are installed, and when so ordered by the area management, the station refreshment rooms are required to supply the staff with good plain food

and non-alcoholic drinks at moderate prices.

In some important stations special dairies have been set up, the multiplication of which is being continued.

In the case of work done under unpleasant conditions (extreme heat or cold), the staff concerned are supplied free of charge with coffee or tea, and at stations where mineral waters are available, the staff are enabled to purchase these at reduced prices, the object of all these measures being to prevent alcohol in any form being used in the beverages available to the staff.

For unmarried employees, in places where housing accommodation is lacking and at out of the way stations, accommodation has been provided where these men can be put up at moderate prices.

2. — Czechoslovakia : State Railways.

Every new entrant into the railway service has to undergo a period of instruction, under the supervision of an experienced employee.

Booklets on *safety precautions for railwaymen* have also been drawn up, and these are sent directly to the employees and explained to them, and they are also reminded of them at frequent intervals. In addition the managements send out each time they consider it opportune *instruction sheets* explaining to the men the various mishaps and accidents and their causes.

In the event of accident, the railway management guarantees to its employees and to the members of their families certain rights, practically equal to those they would obtain had they been insured against accident by ordinary insurance companies.

3. — Rumania : State Railways.

The steps taken to prevent accidents to the staff consist of oral instructions given by the heads of each workshop or operating centre, by service instructions,

and by protective guards fitted as necessary to the machines, tools and mechanical equipment of each workshop.

In case of accident occurring during service, the personnel has the right to :

- a) medical treatment;
- b) leave for medical treatment not exceeding one year, the payment of the full salary being provided for the first six months, and half salary for the following months;
- c) special compensation, independently of the pension, by reason of a regulation put in force in 1929.

Besides the above measures, the staff, members of the insurance fund, receive a payment in money in the event of illness.

The compensation given to the staff who have been the victims of an accident varies according to a scale depending upon the degree of incapacity. These arrangements, however, are only definite if the employee who has suffered from an accident undertakes to make no other claims through the usual legal channels.

These compensations are the following :

1. In the event of death, the widow and children receive compensation equal to 25 times the monthly pay;

2. In case of permanent incapacity, the indemnity represents 30 times this amount;

3. In the event of partial incapacity amounts varying with the degree of incapacity from 10 to 60 % of the compensation provided under heading 2) are paid.

The supervision of the buildings used by the staff from the hygienic point of view is under the head of the service under which the said building is placed; as regards the sanitary inspection of the buildings over the whole of the railway, this comes under the higher inspectorate of the sanitary service.

With the object of suitably lodging the operating staff when away from their home station, at the most important stations or at the ends of sections at which the train staff is changed over, buildings with all necessary equipment such as dormitories, mess rooms, etc., have been provided.

The initiative for building and extending such buildings is in the hands of a special service known as « the autonomous administration for the protection and help of the Rumanian railway staff » organised on the principles of a public and commercial administration, which receives from the Rumanian Railway Administration, in order to form the necessary funds, a contribution of 5 % of the receipts from its passenger and goods traffic. (The contribution of the administration for the 4 first years has been 400 000 lei per annum).

4. — Switzerland : Federal Railways.

In order to protect the staff from accidents, this administration has set up a special service, known as the *prevention of accidents service*, the duty of which is to decide the causes of accidents by methodical analyses, and to make use of the information collected in this field by putting forward measures for avoiding the recurrence of such accidents.

All the men have to be insured against accidents, whether they are fully trained or not, in the Swiss national accident insurance fund, which, in conformity with a federal law, provides medical and pharmaceutical assistance, monetary allowance while out of work, pensions for incapacity (the maximum being 70 % of the annual pay), pensions to dependents (the total cannot exceed 60 % of the annual pay of the assured), and funeral expenses.

In the case of accidents occurring in service, the Federal Railway Administration grants its employees special supplementary allowances. The control and

improvement of the hygienic conditions in the premises used by the staff fall on the medical service.

Dormitories, mess rooms and other equipment, such as baths, showers, etc., have been provided at all the important stations, as in the repair shops, and are at the disposal of the train staff.

5. — Poland : State Railways.

With a view to protecting the staff from accident, technical steps have been taken and special instructions have been widely distributed.

The measures taken to assist the staff involved in accidents and their families, have been given in the reply to question No. 16.

The supervision and improvement of the hygienic conditions of the buildings used by the staff come under the sanitary service.

In all the stations at which the train staff are relieved, dormitories, mess, rooms, baths, showers, etc., have been provided and placed at the disposal of the staff.

6. — Bulgaria : State Railways and Harbours.

No reply to this question.

7. — Yugoslavia : State Railways.

The measures taken to protect the staff from accident are both technical and by means of regulations.

In order to give first aid to the injured all service posts (stations, locomotive sheds, etc.) are equipped with ambulance material.

All the men are insured against accident.

The administration has its own sanitary organisation, which is responsible for the supervision and the improvement of the hygienic conditions of the buildings used by the staff, for whom in addition at the important centres, dormitories, mess rooms, baths, etc., have been provided.

8. — Sweden : Grängesberg-Oxelösund Railways.

The railway inspection service issues instructions on the measures to be taken to prevent the staff injuring themselves. The men injured and their families receive the assistance laid down in the law regarding accidents at work.

Dormitories are at the disposal of the train staff.

QUESTION NO. 18. — Social works.

What is the object of the social works instituted by the railway from a health point of view : Kindergartens, milk issues, dispensaries, home visits from qualified nurses, sports grounds and equipment ? Or to develop the general knowledge of the employee or of his family (evening classes, household management classes, training schools ?)

Have you instituted scholarships to facilitate the education of the men's children ? What support do you give to the sporting, musical and travel societies, as well as to the mutual help and insurance societies formed by the men ?

Have you provided any facilities for supplying general goods to the staff either by direct sale (stores) or by assisting in setting up cooperative stores ?

Do you publish any magazine for the use of the staff ?

Have you provided libraries for the use of the staff ? Do you arrange conferences other than those dealing with service questions ?

How do you provide the funds required by your social work ? What results have you obtained therefrom ?

Indicate to what extent the railway system has concerned itself with the housing of the staff and give on this subject all interesting information, in particular :

The number of houses built by the railway and put at the disposal of the men ;

The proportion of the men living in these houses relatively to the total strength of the staff;

Indicate upon what basis the rents applied were established.

Has the railway system taken any part in the construction of buildings for public use (schools, assembly rooms, co-operatives) used by the staff and their families?

Indicate if you have taken any steps to assist the staff in acquiring property, for example by granting monetary aid towards the purchase of land and the building of houses. Give some particulars of the method of granting the aid, such as for example, if it is in the form of a loan.

Replies.

1. — Germany: German State Railway Company.

The budget of the Reichsbahn makes provision each year for funds to assist the institutions or associations devoted to looking after the sick employees and their sick children, to encouraging sports, and to equipping and maintaining the hospitals founded by the professional associations.

The associations of the staff, formed to develop the social works mentioned above, associations which, having no political nor religious connections and being open to all employees or workmen, have at their disposal a certain number of hospitals, sisters of charity who are fully qualified nurses, orphanages, etc.

The woman's associations, also coming within the general organisation of the Reichsbahn, devote themselves especially to questions relating to the house and families of the members of these associations.

The orphanages (Reichsbahn-Waisenhaus), the institution of which received the support of the Reichsbahn, devote an important part of their activities to

the care to be given to the children and to their education.

These establishments, which are supported by gifts from the staff and subsidies from the administration, provide all the necessary means (scholarships) to enable the orphan children to enter a trade (in the case of young boys), domestic instruction (in the case of young girls) so that they may be able to do house work.

Sports. — The sports are encouraged by the Reichsbahn who with this object have built stadiums and gymnasiums on land belonging to it. The present financial conditions however are making it necessary to impose certain restrictions in this direction.

The steps taken to develop the general knowledge of the staff, and that of their families, were dealt with in the report presented at the Madrid (1930) Congress (Cfr. Report No. 4, Question XV, Madrid Congress, *Bulletin of the Railway Congress* for April 1930, p. 1197).

As regards *musical associations*, no special funds are provided, the administration only supporting these associations when it receives requests to do so; this is also the case of the travel associations, which so far have not asked for assistance from the Reichsbahn.

The self-aid associations to meet death, theft, fire, etc., receive the support of the administration, which places at the disposal of the respective associations the necessary buildings, while the maintenance of the associations is assured by contributions deducted from the salaries.

Supplies of fuel. — Each area management has set up an organisation in the form of a cooperative society, which since 1922 has arranged to supply the men with fuel, thereby securing them certain advantages.

Other cooperatives for the supply of various goods and food supplies do not receive official support.

Reading rooms and libraries. — With the exception of the service instructions no other official organ is issued for the use of the staff; as regards the existing libraries, they have only been organised to be consulted on service questions. For this reason the staff associations make provision for the papers, and in the most important centres the libraries, which belong to them. In this way the « Verkehrswissenschaftliche Lehrmittelgesellschaft m. b. H. » places at the disposal on the staff, at very low prices, books and special reviews.

All the above mentioned social works are financed by the Reichsbahn and by contributions from the staff.

Their results are seen by improvements in health, by a growth of the feeling of a common bond of union, an improvement in the living conditions, and finally by the staff working with good heart.

Housing of the staff. — The question of the housing of the railway staff has always been considered as a problem of the greatest importance, both formerly under the various German States, and at present, when it does not cease to be carefully considered by the Reichsbahn.

The building activity which was intensive before the war, and which was stopped during hostilities, has subsequently been taken up again by the Reichsbahn as the necessity for housing accommodation for the staff became more and more felt. The present facilities being reduced, the administration at the present time has been obliged to discontinue erecting buildings at its cost, although it continues to encourage, by loans to approved cooperative societies and building societies, the construction of new housing accommodation for the staff. On the basis of loans granted, the Reichsbahn arranges to have a right to use these premises as well as to take part in deciding upon the rents. The financing of these

buildings has been dealt with in the following way : upon the sum representing the cost of construction, 40 % can be supplied by various loans, about 20 % represents the amount provided by the Reichsbahn, 20-25 % the part allowed by the State, and the communes, while the rest, 10-15 % is covered by the undertaking.

By these means the Reichsbahn has succeeded in having a large number of houses built for the use of its staff, with the added advantage that it is not concerned in the management of these buildings.

The Reichsbahn also gives its support to the construction of new housing by putting at the disposal of its men the necessary land under favourable conditions. Thus it pays part of the interest on the capital lent to lighten as much as possible the cost of the building, while assuming on the other hand the guarantee of the advances made.

The tendency at the present time is gradually to stop granting loans for the construction of new houses. As for the houses the need for which is still felt, they can only be built on the basis of assistance granted by the administration towards meeting the interests on the capital.

As regards the construction of new collective buildings, employees cooperative societies have been formed with the help of the Reichsbahn.

In addition the Reichsbahn has taken a large part in the work of several development companies whose object is to build houses for the railway staff.

The number of houses or apartments for the use of the staff is about 180 000 which represents a proportion of 26.51 per 100 men.

As regards the houses belonging to it, the Reichsbahn charges a rent which includes a percentage calculated relatively to the pre-war rent; to which is added an additional sum representing the taxes, rates, etc.; as regards houses

built with the assistance of the Reichsbahn the rent has been fixed in each particular case subject to the approval of the Reichsbahn. In the case of the construction of public buildings (schools, churches, etc.), the Reichsbahn as a rule does not make any contribution. As however, it was necessary for service reasons to organise housing schemes in certain outlying localities, the Reichsbahn found itself obliged, at the request of the State, to build for the use of these communities, schools, churches, etc., or to contribute towards their construction.

Acquisition of property. — During the first years the staff was encouraged in this direction by advances. Thus since 1924 up to the present 2 139 properties have passed into the hands of the staff of the Reichsbahn. In future, however, in view of the present depressed financial conditions, these loans will no longer be granted.

2. — Czechoslovakia : State Railways.

The administration manages without charge the following funds :

- a) special aid allowances of the sickness fund;
- b) special fund (for loans, etc.);
- c) special fund to assist the campaign against tuberculosis, chiefly built up from contributions from the men.

In addition the men are allowed advances on their pay which are paid back monthly.

A grant is also made to the sporting societies.

A store for foodstuffs has been set up and in a number of districts the staff has formed 33 cooperative societies in all, with 250 shops, housed in buildings lent by the administration, in the stations.

These cooperative societies are granted a reduction of carriage charges over the railway of 50 %, and in order to

make purchase therefrom, the administration authorises a free pass twice a month, as well as the free carriage of provisions up to a weight of 50 kgr. (110 lb.) per man. In addition foodstuffs and all other articles of ordinary use are sent at special rates.

The administration of the State Railways contributes as regards the housing of its staff, to the construction of new buildings by granting under favourable conditions loans from the special fund mentioned above, and also by granting under certain conditions, reduced rates for the carriage of the materials used in the building.

3. — Rumania : State Railways.

The action taken in this direction, by setting up dispensaries fitted with all the necessary equipment required in modern therapeutics, the institution of orphanages for the children of men who died in service, etc., has given encouraging results. The administration also supports associations of employees in their educational activities, by placing at their disposal the necessary buildings; in the same way it encourages the sporting and musical associations by granting them the facilities required to develop their activities.

The supply of foodstuffs, etc., to the staff by cooperatives has not been encouraged by the railway administration, the results obtained in this direction by other State institutions not having been very satisfactory for various reasons. It does however assist the staff in certain cases to purchase various materials : such as clothing (cloth, shoes, etc.), by guaranteeing the repayment from sums held back from the pay. With this object it has made agreements with several commercial undertakings whereby the railway staff is supplied at market rates by making monthly payments, free from interest, over a period of six months.

As regards the supply of foodstuffs,

the administration has taken steps to issue to the operating staff alone certificates known as marketing tickets, which give the men the right to travel and to convey free of charge a certain quantity of foodstuffs over given sections of the line.

The administration also grants reduced rates for the conveyance of fuel for the staff. The supply of fuel can be arranged either directly by the employees or by their associations or by the stores department, the results obtained in the latter way having been very satisfactory.

The administration of the Rumanian Railways prints three periodicals :

1) the *Official News Sheet of the Rumanian Railways* which appears once a week and contains the orders and instructions which the whole of the staff have to know.

2) the *Saptamana C. F. R.* (The Rumanian Railway Weekly), a review distributed free of charge to the staff, which contains special articles, written in a simple way, instructive literary notes, vulgarised science, sporting news, various information in connection with railways, etc.

3) the *Technical Review of the Rumanian Railways* which appears monthly.

The creation of technical libraries belongs separately to each service, the administration providing the funds required therefore. The construction of living accommodation for the staff has been and continues to be a subject of immediate attention by the administration, and even more so today, when the heavy financial conditions which followed the war have to be met, than in the past when the need for houses was not so pressing.

With this object, a special service has been set up, the « autonomous fund for the protection and help of the staff »,

which in conformity with the requirements of the law which covers its organisation, builds houses for the staff, the necessary funds for this undertaking being covered by a tax of 5 % imposed on the passenger and goods rates.

In this way the administration makes available for its men :

1) housing in buildings attached to the stations, depots, etc., for staff directly attached to the operating department, and

2) houses built by administrations not under the railway, in the attached provinces, or consisting of buildings erected by the Rumanian Railway Administration under the form of separate buildings or whole blocks of flats in localities where the lack of housing accommodation was most felt.

When these buildings are used the lodging allowance alone is taken off the pay of the employees and men.

Owing to the lack of housing accommodation arrangements have been made that the period of occupation, at the present time limited to the time they leave the service (through transfer, retirement, etc.), shall be limited to 5 years for the staff who are not necessarily obliged to remain at the place at which they work; these arrangements are making it possible to give the various classes of staff accommodation in turn.

The railway administration has taken part in the construction of buildings of general utility in the sense that it has caused to be built in the parts of towns reserved for its staff, schools, churches, etc.

As from 1920-1921, building land has been put at the disposal of the staff at reduced prices, and at the same time loans have been granted, which can be paid back over a long period, for the construction of houses. At the present time it is necessary to give up this system.

Under certain conditions, loans the value of which is proportional to the salary are granted to meet mortgage charges to certain classes of men who have the land and capital and are anxious to build houses on their own account.

4. — Switzerland : Federal Railways.

So far no necessity for setting up social works from the health point of view such as kindergartens, dispensaries, etc., has been experienced. Sports grounds and equipment have not been provided at the cost of the administration. On the other hand in order to develop the general knowledge of the men facilities have been granted them to attend courses of instruction in languages, shorthand, etc., by repaying them the whole sum of the fees they would have had to pay for attending these courses of study.

No scholarships have been instituted to facilitate the education of the children of the men. An annual subsidy is given to the musical societies formed by the men.

The railway system does not take any action with regard to the supply of foodstuffs, etc., to the staff. The men themselves have founded in certain places co-operative purchasing societies without, however, any assistance from the management.

The administration publishes a journal for the staff : the *Bulletin of the Swiss Federal Railways* (C. F. F.), and possesses a central library the books in which are placed at the disposal of the staff gratuitously.

To meet the question of the housing of the men, the Federal Railways have put at their disposal on the one hand service houses, and level crossing houses, the latter for the permanent way staff, and in addition lodgings which are rented.

The rent an employee has to pay for the use of service accommodation is fix-

ed in relation to the price of rents in the locality as well as the pay the man earns.

In the case of rented accommodation, the agreement is regulated by a contract, the rent being fixed on the basis of the usual rent of the locality.

At the present time the administration has a total number of 3 072 dwellings, which means that rather less than 10 % of the total of the staff is lodged by the administration.

The administration has also given its assistance to the staff building societies by granting them loans on mortgage. The cooperatives have built 1 125 houses with 2 334 apartments. Loans have also been granted to the men in order to enable them to build or buy a house.

5. — Poland : State Railways.

Hospitals, convalescent homes, etc., belong to the Administration who also supports a large number of other social works (kindergartens, milk issues, summer camps, sporting societies, etc.). The railways have instituted scholarships at the higher schools for the children of the men; for the secondary State schools the fees are reduced by 70 %, whereas in the case of private schools part of the fees are repaid.

The sporting, musical, travel, and mutual aid societies, etc., are encouraged as far as possible by giving them accommodation and grants.

As regards the general supply of food, etc., to the staff there are no stores, but co-operatives are favoured.

Papers for the use of the staff are not published by the administration, but grants are made to the journals of the men's associations.

Besides the travelling libraries, conferences dealing with other than service questions are often given, and are very well attended by the staff.

The budgets of the social works are supplied by subscriptions, contributions from the men, bazaars, dances,

lotteries, etc., the results obtained being good.

The question of the housing of the staff is one which greatly occupies the administration, which does all it can to increase the number of these quarters. Up to the present 34 567 apartments have been provided by the railway. The men who live in them represent 17 % of the total staff.

Living quarters attached to the service posts are given to the respective men, who do not receive a lodging allowance. The rent of the other apartments are got out according to the nature of the apartments themselves and the locality in which they are situated.

The railway system also takes part in providing buildings of general use, which are used by the staff and their families.

The employees can obtain from the Administration loans free of interest to purchase land and build houses.

6. — Bulgaria : State Railways and Harbours.

In order to improve the conditions of existence of the men and to raise their cultural level, the Railways and Harbours Administration has created the following funds :

1st : « Housing, institutions, hospitals and pensions for the employees of the railways and harbours », and

2nd : « Scientific papers and technical inventions ».

These funds are obtained chiefly from the fund for providing the staff premiums.

With the funds available under 1, the administration has built :

a) 98 blocks of apartments for 634 families of the staff (i. e. about 5 % of the total staff). The rent is fixed according to the number of rooms, the money so obtained being paid into the « fund for the maintenance and repair of the apartments »;

b) 5 health resorts : one hydro-

pathic, two seaside, and two climatic. In addition, owing to the participation of the State in the construction of a sanatorium for tubercular cases, the right to 20 beds has been obtained for an indefinite period;

c) medical building at Sofia, fitted with the necessary equipment;

d) a boarding establishment for the children of the junior employees of the operating department.

With the sums available from the second fund :

a) a *Bulletin* is issued monthly for the staff, containing service notices and general matters affecting the railways;

b) works on railway or financial questions are published;

c) a scientific library has been set up which can be used by the staff;

d) 16 libraries are maintained with various classes of books at different centres of the railway.

There is also, for the benefit of the staff, a mutual assistance and saving fund, which is fed by the contributions from the employees who are obliged to be members.

The members can obtain loans, assistance in case of illness, or in case of discharge from service, etc., as well as scholarships for clever children.

7. — Yugoslavia : State Railways.

With the money in the sickness assistance fund, sanatoriums, convalescent homes for children, etc., have been built.

The railway gives its material and moral support to sporting, musical, and other societies, formed by the men, and also helps in organising co-operative societies for the purchase of the supplies required by the staff.

A technical journal is published, and grants are made to the journals of the men's organisations.

The administration has provided up to the present 11 300 apartments, so that 34 % of the men live in such apartments, the rent being 1/5th of the usual rate.

8. — Sweden : Grängesberg-Oxelösund Railways.

The railway contributes to the reading and educational associations as also to the temperance societies formed by the staff.

During the years 1917-1920 the railway facilitated the obtaining of provisions by the staff by selling foodstuffs to them directly.

The staff, to the extent of 30% of its strength, occupies 555 apartments built and put at their disposal, the rent being fixed by agreement.

Loans are granted to the men in order to facilitate the purchase of property, a society guaranteeing such loans.

In order to pay their taxes and rates, the whole of the employees have formed an economic union, which meets these payments out of money deducted from the paysheets with, in addition, the contributions of the Administration.

CHAPTER V.

Collaboration of the staff in the undertaking.

Institution of the system of staff delegates.

QUESTION No. 19. — *Does this system of delegation apply to several grades of the staff? In particular, is it allowed when dealing with the manager, the chief of each of the principal departments, and the immediate chief of the man in question?*

What is the method of nominating the delegates?

What are their duties and functions? Is the intervention of the delegates more especially in questions of pay, supple-

mentary benefits (bonuses in particular), promotion in rank and disciplinary matters?

Give all particulars of interest on the general functioning of the system of delegation.

Replies.

1. — Germany : German State Railway Company.

Delegations of the clerical staff and of the men of the operating staff are being instituted in conformity with the decisions of the Reichsbahn.

The members of these delegations are elected in conformity with the methods laid down in these decisions.

The duties of these delegates are as follows : unconditional support of the Institution, under all forms (such as suggestions to the Administration and advice given to the staff), with the object of increasing the output of work and making certain that the work is carried out under the most economical conditions; efforts to tighten the bonds of union between the Institution and the staff by submitting to the Administration all real grievances arising in connection with the work; putting forward the point of view of the staff in connection with the introduction of new methods of work, the drawing up of service instructions, when deciding rates of pay, etc., in brief, on all questions or measures referring in a general way to the personal relations in the service of officials, employees and workmen, the delegates being their mouthpiece.

2. — Czechoslovakia : State Railways.

Committees of delegates elected by the employees having a purely consultative character exist on the State Railway Administration, the role of these committees being limited to personal and social matters which affect the whole of the employees.

3. — Rumania : State Railways.

There are no officially instituted delegations of the staff on the Administration of the Rumanian Railways, except in the managing committee of the autonomous fund for the protection and help of the staff of the Rumanian Railways, on which out of the 11 members composing the committee, 5 represent the officials, employees and workmen.

There are however certain associations of the men of different branches of the undertaking, to the institution of which the Administration has given its approval. These associations can through their delegates voice any grievances on subjects of a material and professional nature (pay, hours of work, etc.), without however their activity ceasing to be of a purely consultative nature.

4. — Switzerland : Federal Railways.

Committees known as staff committees have been set up at the general headquarters and also to deal with the head of the repair shops and are primarily concerned with questions of a technical and professional nature and do not take any part in questions of pay, promotion, or discipline.

These committees, elected by secret ballot by the staff, have displayed during these last years a considerable activity, and have carried out their duties to the satisfaction of the Administration and the staff. They have collaborated intelligently in drafting regulations and instructions, and have also facilitated their application.

The staff also participates in the administration of the pensions fund and the assistance fund, by their representatives elected by secret ballot.

5. — Poland : State Railways.

The system of delegations of the staff dealing with the management does not exist.

6. — Bulgaria : State Railways and Harbours.

The system of delegations of the staff does not exist on the Bulgarian Railways, the staff being represented on the discipline council alone.

7. — Jugoslavia : State Railways.

The system of delegations of the staff has been set up as between the workmen and their immediate chiefs alone.

8. — Sweden : Grängesberg-Oxelösunds Railways.

The system of staff delegations has been set up in the ten lowest grades of the staff, and in certain cases in the 11th to 16th grades out of the total of 30. The role of the delegate of each class of employees is consultative, as regards questions of promotion and questions of discipline.

QUESTION No. 20. — *How are the suggestions of the staff put forward and dealt with? How are they discussed?*

Quote cases of improvement in the service through suggestions put forward by the staff.

Replies.

1. — Germany : German State Railway Company.

Every proposition dealing with the service should be put forward in writing and through the regular channels. The staff is encouraged in this direction by being given awards when they have put forward suggestions as regards the organisation, either for improvements or to propose various devices, etc., the value of which has been proved.

Under this heading can be quoted many mechanical devices and different methods devised by the staff to improve the working conditions.

2. — Czechoslovakia : State Railways.

The suggestions of the men are put forward through the regular channels to

the managements, and in the event of their utility being proved their authors are rewarded.

As a rule the suggestions of the staff deal chiefly with the organisation of the indoors service.

3. — Rumania : State Railways.

In general the suggestions to improve the service are put forward through the usual channels, such as by interviews with the departmental heads, and are taken into consideration as soon as their value has been proved.

A monetary reward is usually granted to the author of suggestions found useful.

Certain headquarters services (such as the financial management) have put into practice in this connection the system of sending once a year to each employee a confidential questionnaire dealing with certain service questions, asking him to indicate the modifications or innovations he considers would assure greater output of work and greater economy. The replies are gone through with care and those of value are examined in greater detail.

Most of the suggestions from the staff deal with the simplification of the working methods.

4. — Switzerland : Federal Railways.

The men who put forward usable suggestions likely to simplify, improve, or cheapen the management or the working are entitled to premiums which are granted according to the principles laid down in the general service instruction No. 19 of the 25 April 1927.

It has been observed very frequently that the men who put forward suggestions with the objects given above, only see one aspect of the question, the one which interests them directly.

A certain number of suggestions, mostly dealing with the improvement of the tools and the mechanical equipment of the shops, have however been made use

of. Some men have also been rewarded for having put forward suggestions concerning the maintenance of the electric locomotives.

5. — Poland : State Railways.

The staff sends its suggestions, after being as a preliminary approved by the respective service of the area management, to the Ministry of Communications, where a special commission examines them and distributes rewards for the best inventions or improvements. As a case of an improvement of this kind, a mechanical truck for use in correcting the gauge and level of the track may be mentioned.

6. — Bulgaria : State Railways and Harbours.

The suggestions system properly speaking does not exist. In the monthly review published by a scientific committee under the general management, intended more especially for the executive staff, a section is provided for suggestions from the staff on matters and subjects upon which the men put forward their points of view in writing.

The suggestions on more important questions are submitted directly by the interested parties to the scientific committee which examines them. If the suggestion is made use of, its author can receive an award.

In addition the scientific committee organises each year a competition on a certain number of subjects dealing with transport.

Some of the suggestions put forward by the staff have resulted in detail improvement in the service: for example, a table facilitating the calculation of the kilometric distances between the stations, simplification of certain office routine, etc.

7. — Yugoslavia : State Railways.

The suggestions put forward by the staff are always submitted to the imme-

diate superior and dealt with as service questions.

8. — Sweden : Grängesberg-Oxelösund Railways.

Nothing to point out.

CHAPTER VI.

Professional instruction.

QUESTION No. 21. — *Apprenticeship.*

Have you instituted an apprentice system.

Under what conditions are the apprentices recruited?

How are they instructed?

Are there special schools for apprentices belonging to the railway?

Are special facilities granted to apprentices, whose abilities have brought them to notice, to improve their future position?

Replies.

1. — Germany : German State Railway Company.

The instruction of artisan apprentices, in the principal repair shops, consists in their attending during 4 years a shop school, where they follow technical and general knowledge courses. In cases where there are no such schools, the apprentices can use the public technical schools, the courses of study of which are completed in the workshops by specialised technical instruction on materials, machines, etc. This schooling, of a theoretical character, is completed by a course of practical instruction over a period of three years in a school workshop, and then by a year's practice in other sections of the shops.

In order to be allowed to attend this school the apprentice must be 14 years of age, hold the elementary school certificate and, in addition, satisfy certain physical and intellectual requirements.

The apprentices showing they possess

certain qualities may be promoted to technical posts normally reserved to officials.

2. — Czechoslovakia : State Railways.

The apprentice service has been suppressed, owing to the fact that very often the apprentices claimed the right to a permanent post, although under age and without having done their military service, which caused the administration difficulties from the point of view of the number of the staff and its stability.

3. — Rumania : State Railways.

The instruction of apprentices in order to fit them for the workshops and the traction services is done in certain schools attached to the main repair shops and to some of the most important locomotive depots.

The courses of study at these schools, the instruction at which is both theoretical and practical, last 4 years. In order to be admitted, the candidates must pass an entrance examination, satisfy certain conditions of age and health, and show they have attained a certain standard of official education (have passed the elementary school certificate).

Deserving pupils receive monetary prizes and books, and those who pass the examinations with success are distributed among the various services in the order in which they pass.

4. — Switzerland : Federal Railways.

As regards the instruction of the staff no new arrangement has been introduced since the enquiry made on the occasion of the Madrid Congress.

5. — Poland : State Railways.

The apprenticeship service has been instituted in the railway workshops alone.

The conditions under which appren-

tices are recruited relate to age, to a certain general and official education which varies according to the posts the apprentices desire to occupy, as well as to the physical conditions needed for the trade.

In addition the parents or guardians of the apprentices are obliged to sign articles of apprenticeship.

The instruction in the workshop schools includes :

1) theoretical instruction in the shop schools;

2) a time of practical instruction in the shops themselves, and

3) general instruction in the State railway schools or at public after-school instruction courses.

Apprentices who have distinguished themselves by their good qualities are allowed by the administration to reduce the period of apprenticeship; in the same way these apprentices have priority in obtaining regular employment.

6. — Bulgaria : State Railways and Harbours.

No special apprenticeship course exists on the Bulgarian Railways. The traction service, however, takes a certain number of apprentice-pupils, who without following special studies or courses, learn a trade under the control of specialist foremen.

The Bulgarian Railways have an intermediate railway school, for candidates for different positions in the administration, the positions varying with the previous official education of the candidates.

7. — Yugoslavia : State Railways.

Each section has its apprenticeship course, the apprentices who bring themselves to notice by their ability being rewarded by quicker promotion and by being put into the best positions.

8. — Sweden : Grängesberg-Oxelösund Railways.

There is no special apprenticeship service.

QUESTION No. 22. — *Entrance examinations for the staff.*

Have you instituted practical tests for would-be entrants in order to satisfy yourselves as to their technical education ?

What are these tests ?

Do you complete these tests by a psycho-technical examination ?

Replies.

1. — Germany : German State Railway Company.

Applicants for employment on the railway have to satisfy certain conditions, namely: a rather wide general education, a certain standard of technical instruction (according to the case), and to produce certificates that they have satisfactorily passed through certain technical schools.

Other conditions relate to their physical capabilities, limit of age, and irreproachable private conduct.

The applicant's possession of the requirements of the different services is proved most frequently during a psycho-technical examination.

The technical instruction of the applicants admitted, as regards their future duties, is carried out according to a definite programme, the final examination which completes this instruction being intended to show to what degree the candidates are qualified for the employment in question.

2. — Czechoslovakia : State Railways.

Neither theoretical nor practical examinations are required of applicants prior to admission; all that is required is a certificate of elementary education or a written testimonial of technical knowledge.

In the case of employment in a service requiring greater qualifications, applicants are obliged to submit to a psycho-technical examination (especially in the case of the train working and commercial services, office work, locomotive and rail motor coach drivers, etc.). All these examinations take place under the auspices of the railway and in conjunction with the Psycho-technical Institute of the Academy of Work.

3. — Rumania : State Railways.

Candidates for the different vacant posts have to fulfil certain conditions as regards age, physical abilities, and possess certificates proving they have satisfied the requirements of certain schools of general or special education (according to the case), commencing with the elementary primary school up to the higher schools (polytechnics and universities).

Among these schools must be mentioned the preparatory technical schools of the Railway Administration (which educate men for the operating department, firemen, foremen, etc.).

Examinations for admission to the railway are not required except for vacant positions in the financial management, for which the applicants possessing certificates or diplomas are admitted on the bases of certain written or oral tests, relating to their specialised knowledge of the subject.

The same condition is required of men in the workshops brought in from outside, these having to undergo examinations in the form of practical tests before they can be taken on.

The psycho-technical examination has not yet been introduced.

In addition to these arrangements, the appointment of the staff nominated for certain vacant posts is provisional for a period of one year, and only becomes definitive at the end of this term as the result of an examination dealing with

general and specialised knowledge of the men in question.

4. — Switzerland : Federal Railways.

The same reply as to Question No. 21. It may also be added that the administration has commenced — among other classes of employees than those already subject to it — to make candidates for train working positions undergo a psycho-technical examination.

5. — Poland : State Railways.

The applicants for the different services have to pass a technical examination and carry out under the supervision of an experienced employee a trial period in the positions desired.

Certain area managements have introduced psycho-technical examinations, but only for experimental purposes.

6. — Bulgaria : State Railways and Harbours.

No employee in active service can be admitted into a service post until he has successfully passed the theoretical and practical examinations required.

The practical examinations are not so far completed by psycho-technical examinations.

7. — Jugoslavia : State Railways.

Applicants are always required to undergo practical tests so that their professional knowledge can be confirmed.

8. — Sweden : Grängesberg-Oxelösund Railways.

No reply to this question.

QUESTIONS NOS. 23 and 24. — *Continuation of the professional education of the men. — Instruction of the permanent staff.*

Do you do anything to improve the professional education of the men in the service by practical courses, and by periods of practical experience ?

Do you take steps to see that this instruction, as well as the capabilities of the men to carry out their duties are maintained at a suitable level by practical tests? by psycho-technical examinations? by competitions between workmen of the same class?

Have you instituted various facilities: courses of study, voyages of enquiry, periods of practical experience, congress, etc., so as to enable the permanent staff to complete its technical knowledge?

Replies.

1. — Germany: German State Railway Company.

The practical instruction of beginners is perfected by systematical instruction, consisting of theoretical instruction and lectures or courses, dealing with new practices being introduced in the administration or in the working (Cfr. Report No. 5, Question XVI, submitted to the 1930 Madrid Congress, *Bulletin* for April of the same year).

There are generally speaking three classes of instruction:

1) Instruction given to the apprentices, to employees or workmen;

2) Instruction for improving the employees, and especially employees attached to the operating department, who if the service is to be carried out properly have need to know the latest methods in connection with the service and the organisation;

3) Instruction for employees and workmen desirous of improving their knowledge.

1) Professional instruction for beginners is given:

a) in beginners' schools (the category in which must also be included the schools for apprentices);

b) in the schools of the administration.

a) The school for beginners is a school common to several services, its object being to complete the professional instruction of the beginners, by enabling them to acquire special knowledge relating to the actual carrying out of the service (such as, general principles governing railway working, the organisation of the different sections of the service, etc.), while developing in them the spirit of order, the love of their work, and a sense of duty. The programme of this instruction should not be overloaded with matters beyond the future duties of the beginners, or which, relating to general knowledge, do not enter into the objects followed by the school. Only in exceptional cases where the local conditions make it necessary, and with the reserve that it is approved by the administration, is the organisation and giving of more advanced courses allowed.

These courses can be attended by:

a) beginners in staff appointments;

b) men holding appointments but who by order or with the assent of the administration have been transferred to a service for which they have not been specially trained.

These special courses may also be taken advantage of by employees who should attend them owing to the kind of service which they are employed in, as well as all other employees who may be admitted according to circumstances and on request.

The instruction at these schools follows the same methods as those used in all other schools, and is completed by practical exercises and demonstrations.

b) The administration schools are intended to prepare the beginners for service in the middle grades in order to make them capable of holding posts under the administration.

Attendance at these schools (those admitted must as a rule have passed

through the schools reserved to beginners, and intend, while devoting themselves to improving their education, to obtain a better knowledge of questions dealing with the organisation of the services and with various economical questions) is obligatory for :

a) junior clerical employees; and

b) beginners directly attached to the technical services; it remains optional only for those employees who by reason of the work they are doing only need to take certain technical courses given in these schools.

2) *Continuation and development of the professional instruction.*

In this matter there are courses of professional instruction properly speaking and conferences organised in the interest of the service, by means of which the development of the staff as regards service questions of local interest is pursued.

The professional instruction of the employees in the outdoors services is given at hours and according to a programme laid down in advance. Thus conferences for the office employees have been organised in this way, as have special courses for certain groups of employees who have to be instructed on the most recent important instructions dealing with the service or with technical innovations.

Attendance at these courses of study is obligatory for all employees, without distinction of age, and in addition for the beginners and for the men who have to be in a position to apply the knowledge acquired to their work.

The courses of study for the employees of the outdoors services are given as a rule separately for the different services: in this way courses for the employees attached to the operating and the train movements on the one hand, and courses of study for employees attached to the permanent way maintenance and to the

signalling and centralisation installations on the other hand, have been organised.

Attendance at these courses however does not confer any right to promotion or to nomination to another post.

The period of the professional instruction which each employee has to receive during the year is fixed according to the requirements of the service.

The courses of instruction like the professional conferences are considered as forming part of the service and can be given during working hours, for the employees as well as for the workmen.

3) *Non official professional instruction.*

In this class all courses of study of all kinds organised with the object of training capable men, of developing and improving their general and special knowledge, are included. With this object the associations of employees and of workmen have displayed much independent activity, being assisted when necessary by the administration.

Organisation of professional instruction.

In order to carry out measures having connection with the professional instruction, there is at a certain number of the area managements, special sections, which occupy themselves with all educational questions as well as with psycho-technical questions, the maintenance of relations with other educational authorities, with the administration of the schools, as well as having the supervision of the libraries and the control of the technical publications. An important measure dealing with the organisation of the professional instruction of the staff has been the institution of a permanent council, under the authority of a management, composed of employees belonging to all ranks, elected from the most capable, which examines and discusses all measures to be taken to meet

the requirements of the professional education. The decisions of this council are issued in a special service order, applicable to the whole of the railway system.

In connection with the professional instruction, two editions of special papers are also issued (*Unterrichtswerkblatt*) and are distributed to the staff, edition A for the men in the administrative service, train working and shops, and edition B for the operating and permanent way maintenance services, these papers containing various questions relating to the service, of immediate interest and of such a kind as to contribute towards the instruction of the staff.

We may mention among other efficient methods for improving the education of the staff, two reviews, the publication of which is approved by the Reichsbahn, *Eisenbahnfachmann* and *Eisenbahnkunde*, which give particulars of all innovations introduced in many fields of railway working, as well as new methods tried in service and dealt with in the form of problems, reports, etc.

2. — Czechoslovakia : State Railways.

The professional education of the employees is assured :

a) by railway professional instruction, and

b) by periodical instruction.

The first is facultative, the second is obligatory.

The institutions giving railway professional education are :

1) schools; 2) courses of study; and 3) conferences.

1) At the present time, on the Czechoslovakian Railways, only schools for the train working and commercial services have been organised. At the end of the school studies, the candidate undergoes a theoretical and practical examination.

2) At the special courses of study,

instruction is given on the subject, systematically condensed, and methodically worked up, of some branch of a given railway service. These courses last 2-3 months, include day courses and night courses, and are organised in conjunction with the most important services (train working courses, commercial courses, telegraph courses for the train guards, drivers, permanent way supervisors, etc.). The men allowed to take these courses are obliged to undergo an examination.

3) The conferences always take place outside working hours, and deal in an independent way with a part of the railway service or with general questions dealing with the service. These conferences can be completed by discussions.

There are no other practical examinations : the continuous practice of the service closely watched by the control organisations, guarantees sufficiently well a suitable level of ability and professional knowledge on the part of the employees.

The courses of instruction and the periodical instruction of the men make it possible also for the permanent staff to develop their own education.

In addition, according to need, the technical staff are sent on voyages of enquiry to various industrial works of the country or even abroad.

3. — Rumania : State Railways.

The development of the professional instruction of the staff in order they may obtain practical knowledge is continued by means of periods of practical experience in the operating and traction services, and also by means of service instructions drawn up and distributed by each service, as well as by oral instructions given to the men by the service controllers, by conferences dealing with some special subject given by the heads of the departments, and finally

by discussions of a professional character between men of the same service, presided over and directed by the respective managers.

With the same object, as has already been shown in Question No. 18, the Administration publishes a weekly and a monthly review of an instructive and technical nature (giving particulars of new inventions, and local or foreign happenings), as well as another weekly publication which contains the service orders and instructions.

In general the knowledge and ability of the employees are tested while they are at work, by their immediate chiefs, and so far as concerns the operating staff, whose work is moreover subjected to the same control, by periodical examinations, which are corroborated by medical examinations, in the case of staff attached to the locomotive service.

In order to train the regular staff, special schools have been set up for the different classes of employees, who are required to hold the certificates granted by these schools, this condition being obligatory both for staff recruited from outside and for the staff in service in the line of promotion.

Educational voyages abroad in order to train the permanent staff have not yet been instituted by regulation. The operating service (i. e. train working and commercial services) alone sends abroad for educational purposes and with the approval of the general management, employees who have shown particular ability.

4. — Switzerland : Federal Railways.

Same reply as to Question No. 21.

5. — Poland : State Railways.

The professional education of the men is completed by special conferences, organised by the heads of the services or by special instructors, attendance at which is obligatory for all men of the

technical services, which conferences take place at least once a month.

The professional education of the men, as well as their suitability for their work, is controlled by means of periodical examinations each year. Psycho-technical examinations have not yet been considered.

A whole series of special courses of study has been instituted to enable the men of the permanent staff to complete their technical education and make sure of promotion.

6. — Bulgaria : State Railways and Harbours.

The system of periods of practical experience for perfecting the knowledge of the men is in use on the Bulgarian Railways.

There are no special courses of practical instruction except those at the railway school.

The knowledge acquired as well as the abilities of the men are checked by the heads of the services.

Psycho-technical examinations and competitions between workmen of the same grades have not been introduced on the Bulgarian Railways.

There are no special courses of study, voyages of instruction, congresses, etc. According to a special regulation, employees who have successfully passed a specially instituted competitive examination are granted leave to study special subjects in Europe. Up to the present however nothing has been done in this direction owing to the lack of funds.

7. — Yugoslavia : State Railways.

For each class of men, the professional education improved by periods of practice, and by practical courses of study.

8. — Sweden : Grängesberg-Oxelösund Railways.

There are normal courses of study as well as correspondence courses for the permanent staff.

CHAPTER VII

Premiums and grants for good output.

QUESTION No. 25. — *Premiums and grants to men in the operating department.*

Have you instituted premiums or grants to reward personal merit, seniority, vigilance, devotion, initiative, the spirit of economy, and in a more special way the quantity and quality of the output?

What classes of men profit by these premiums (supervisory and managing staff on the one hand and executive staff on the other) in the operating service?

In what way are these premiums and grants applied (formulae, base rates, individual or collective deductions in case of bad work, etc.)?

In what proportion do these premiums and grants increase the normal pay of the men?

Do you intend to extend the practice of giving output premiums?

Replies.**1. — Germany: German State Railway Company.**

The Reichsbahn budget makes provision for certain sums which are allocated to the staff over and above the ordinary pay on the basis of individual regulations, and which are designated, according to the object proposed, under the names of rewards (Belohnung) indemnities (Vergütung), grants, premiums (Leistungszulagen), etc. These sums are distributed on the one hand to the staff attached to certain services, and on the other to all employees without distinction, but only when their contribution to the work done has exceeded the quantity that can justly be expected of them. All these additions when added together represent about 4 % of the total pay of the active staff, and less

than 2 % of the pay of the whole of the staff.

The additions allowed are the following :

a) *indemnities for night work*, allocated to the staff (clerical and workmen) of the operating service whose work is done between midnight and 4 am. (0.50 Rm. per night for additional food).

b) *Premiums for the staff in shunting yards.* — These premiums are allocated to the staff (clerical and workmen) attached to this service with the object of inducing them to increase the amount of work they do, while reducing to a minimum the damage occasioned when shunting. These premiums in the case of abnormal train movements are 0.25 Rm. per head and per turn of duty.

c) *Premiums for heavy traffic* (record distances) payable at certain stations and in certain cases (such as exceptional traffic, intense circulation of trains at the time of annual fairs, exhibitions, seasonal traffic, etc.), in order to make the men do the maximum amount of work (clerical and workmen). These premiums are distributed to the staff in varying amounts and upon the recommendation of the head of the respective services.

Vigilance premiums are granted to the employees who by their own initiative have been able to avoid damage to the equipment, vehicles, etc.

Grants up to as much as 200 Rm. are given to any man whose definite intervention in time has avoided a serious operating accident or has reduced the consequences in an appreciable manner, as well as when he has assisted in the discovery of the authors of crimes or damage.

Rewards for useful inventions are given on the occasion of schemes of improvement dealing with the train working, operating, organisation, etc., being considered.

Premiums for firemen at stationary boilers are granted based on the saving of fuel.

Indemnities for educational work are granted to the men who in addition to their ordinary work give courses of instruction at the beginners' schools, professional schools, administration's schools, etc., these indemnities varying between 2.50 to 6.60 Rm., in exceptional cases being as high as 10 Rm. per hour.

Premiums for fines imposed on smokers found in compartments reserved for non-smokers, premiums for fraud discovered in the waybills, premiums instituted with the object of lessening the losses and damage which the guards may be responsible for, premiums in connection with the sale of tickets at the ticket offices, and with the goods operating service are paid directly by the Reichsbahn to the operating staff.

All these premiums, indemnities, etc., are not equally distributed to each man, so it is not possible to estimate the proportion of the amount distributed relatively to the usual salary.

2. — Czechoslovakia : State Railways.

Up to the present the system of special premiums has not been introduced in this service; pecuniary grants are made however, to all classes of employees.

3. — Rumania : State Railways.

For all men in the operating service (movement and commercial) in the outdoors services as at headquarters, premiums for better output of work have been instituted.

These premiums are allocated according to rules laid down in the regulations which consider both the importance of the class of service of the man and the quality of the service carried out. These conditions are carried out by adding to the basic premium, coefficients for the class of service of the man, and others, two in number ac-

cording to the quality of the work accomplished, the coefficients or notes of qualification serving, the one to qualify the unit of which the man is part, the other the individual action.

For the train staff (drivers, head guards, brakemen, etc.), the output premium is calculated according to the kilometres run and to the class of train worked.

In addition certain grants are made to those employees who distinguish themselves by acts of vigilance, devotion, initiative, etc., as well as to meritorious members of the retired staff.

4. — Switzerland : Federal Railways.

Same reply as to Question No. 21.

5. — Poland : State Railways.

The following premiums have been instituted in the operating service : economy premiums for the locomotive service; premiums for the satisfactory utilisation of the rolling stock on goods trains, and finally premiums for the good utilisation of wagons used in parcels traffic.

The premiums are granted on the one hand to the managing or supervisory staff, and on the other to the executive staff according to a certain percentage.

The calculation of the premiums for shunting is done according to basic rates fixed for each station for a certain period, and according to the nature of the traffic, the period having to be at least 6 months.

Premiums are granted for the satisfactory utilisation of the rolling stock for a satisfactory output of work from the locomotives and for a better utilisation of the wagons, according to amounts fixed for each particular case.

The earnings of the employees may be increased up to as much as 40 % by these premiums (usually by 5 to 10 %).

The present system of premiums appears to be satisfactory.

6. — Bulgaria : State Railways and Harbours.

Since 1923 the system of premiums has been instituted and applies to all the staff, these premiums being intended to interest the staff in the quantity and quality of the output. The proportion of these premiums to the salary of the employees is as high as 20 %. However, in spite of the favourable results obtained, all these premiums were suppressed as from the 1st April 1931, in view of the depressed financial position of the State.

7. — Jugoslavia : State Railways.

The premiums and grants paid to the men are regulated by law and by the regulations.

8. — Sweden : Grängesberg-Oxelösund Railways.

There are no premiums for the operating staff.

QUESTION NO. 26. — *Premiums and grants for staff in the rolling stock and traction services.*

Same questions as for Question No. 25 as regards the staff employed in the rolling stock and traction services.

Replies.

1. — Germany : German State Railway Company.

The premiums granted to the traction staff (head drivers, spare drivers, firemen and assistant firemen) are of two kinds :

a) premiums for savings in fuel, calculated and paid monthly, which can be as much as 1.5 % of the total cost of the fuel consumed.

b) mileage premiums, which are granted to the staff concerned according to determined rates, in cases in

which the normal mileage between two heavy repairs of the locomotive has been exceeded.

2. — Czechoslovakia : State Railways.

The various premiums granted to the executive side of the traction service may be enumerated in the following order :

a) premiums for savings made and for getting better service out of the locomotives, to the supervisory staff of the locomotive sheds;

b) premiums for fuel and oil economy, for the locomotive drivers and firemen, leading drivers, shed supervisors, fire-lighters, and fuel supervisors;

c) premiums for saving fuel and lubricants at the pumping stations, by the pumpmen;

d) premiums for fuel economy for the firemen at boiler houses used for heating passenger trains;

e) premiums for shed supervisors having to prepare the train locomotives by a given time;

f) reward for having stopped a train in time before reaching a pair of points incorrectly set;

g) premiums for discovering defects and damage to the stock.

The economy premiums are always based on 1 000 ton-kilometres gross.

In the workshop service the following premiums have been instituted :

a) premiums for the supervisory staff in the operating service, calculated by means of the formula :

$$100 \frac{a-b}{ad} c \quad (\text{expressed as a percentage}),$$

in which :

a = the number of authorised posts,

b = the number of posts filled,

c = the nominal value of the rolling stock used,

d = the actual value of the rolling stock used.

b). premiums for the executive staff of the operating services of the shops, allocated in terms of the application and ability of workmen working on piece work.

In addition the drivers and firemen of stationary plants are given premiums for fuel economy, based upon the content of CO² in the combustion gases.

Premiums are also given for savings effected and for increased output in the traction and shop services, these being granted to the supervisors. These premiums take into account the total savings realised in the service and are divided between the different men according to the importance of their position.

3. — Rumania : State Railways.

The premiums granted to the traction staff are the following :

a) For saving of time paid to the locomotive men for the minutes of delay made up (against this the minutes lost which can be ascribed to them are deducted).

b) For saving of materials (fuel and lubricants) to the workmen and labourers of the depot, to the locomotive men, and to the administrative staff of the depots.

These premiums are calculated upon the basis of the allocations of fuel and lubricants laid down at the present time per train-kilometre run. The allocation will shortly be made on the gross ton-kilometres.

c) As regards the mileage run, the locomotive men receive mileage premiums according to a progressive tariff.

The total of these premiums amounts to as much as 70 % of the locomotive men's pay, and 30 % of that of the administrative staff of the depot, and the workmen and labourers.

In addition there is a premium for keeping the locomotives in proper order and in a clean condition, paid to the

staff doing this work, as decided by the man in charge of the depot.

As regards the workshops and rolling stock, premiums are granted to the supervisory and control staff, in order to get an increase of production. These premiums are calculated from certain standards laid down in the regulations.

Generally these premiums increase the pay of the men up to 35 %.

Proposals have also been made for premiums for the staff in charge of the electric lighting of trains.

4. — Switzerland : Federal Railways.

Same reply as to Question 21.

5. — Poland : State Railways.

As regards the mechanical service there are premiums for the quantity and quality of the work done as well as for materials saved. The first premiums are granted to the workmen, to the administrative staff of the shops and sheds, and to certain management employees, directly attached to the operating. Premiums for savings of fuel and lubricants are granted to the locomotive drivers, drivers of pumping stations, etc.

Special rewards are granted according to fixed standards for each case, and the salary can be increased by 100 % as a maximum and by 40 % on the average.

6. — Bulgaria : State Railways and Harbours.

Premiums on the work done distributed in accordance with certain standards are allocated to the workmen and staff controlling the repair workshops. These premiums can increase the salaries up to 15 % and on the average by 4 to 6 %.

The locomotive men receives premiums on the mileage run as well as premiums on the savings of fuel and lubricants.

7. — **Jugoslavia : State Railways.**

No reply to this question.

8. — **Sweden : Grängesberg-Oxelösund Railways.**

The locomotive staff were formerly granted premiums for saving fuel and lubricants, but these have been given up as the staff who wished to increase the premiums received took care to effect excessive economies which resulted in hot boxes and insufficient steam pressure.

QUESTION No. 27. — *Premiums and grants to men of the permanent way and works service.*

Same text as for Question No. 25 but referring to the men of the permanent way and works service.

Replies.

1. — **Germany : German State Railway Company.**

Special premiums for the employees in the maintenance service will shortly be instituted, based upon the day's work as carried out but also taking into account the fact that there should be a certain amount done under the double headings of quantity and quality.

2. — **Czechoslovakia : State Railways.**

A commercial system of premiums is being developed according to which the grants paid out will be based upon the working results. The former system which consisted in paying premiums for savings made on the sums set aside for the permanent way maintenance has been given up as unworkable.

3. — **Rumania : State Railways.**

Special premiums are granted for increase of output to the outside staff of the permanent way and works service (inspectors, sections, districts, head gangers and platelayers). These premiums are calculated according to cer-

tain definite standards and are granted to the staff by means of qualifying notes for the service unit as well as for the individual.

4. — **Switzerland : Federal Railways.**

Same reply to Question No. 21.

5. — **Poland : State Railways.**

There are no premiums properly speaking for the permanent way and works service, with the sole exception of grants allowed to men who discover broken rails.

6. — **Bulgaria : State Railways and Harbours.**

Same reply as to Question No. 25.

7. — **Jugoslavia : State Railways.**

No reply to this question.

8. — **Sweden : Grängesberg-Oxelösund Railways.**

Other premiums than those mentioned in the reply to Question No. 26 have never been given.

Special cases.

Premiums or grants common to several services.

QUESTION No. 28. — *Are there premiums or grants or special advantages (special promotion, honorary rewards, etc.), granted to the men as a reward for services that have not been brought within the limits of Questions Nos. 25 to 27 ?*

The Railways are particularly asked to mention in replying to this question premiums or grants affecting men in the headquarters management, or those common to the men of all services.

Replies.

1. — **Germany : German State Railway Company.**

Beside the payments and additions dealt with under Questions Nos. 25 to

27, to all employees and in some cases to the labourers or staff on contract (Angestellte) a premium (Leistungszulage) is paid, which is allocated under two forms :

- 1) as a regular payment, and
- 2) as a lump sum payment.

Under the first heading, these additions are quarterly, and are granted to men in posts of considerable responsibility who have shown themselves particularly well able to carry out their work, or to men who have distinguished themselves when carrying out the duties of a higher grade position.

Under the second heading the premiums are granted to employees and staff under contract who while not entirely meeting the conditions given above have distinguished themselves in other directions in such a way as to deserve premiums at intervals more widely spaced than quarterly intervals, such as to officials who by additional work have made good the shortage of staff (through holidays, illness, etc.).

The value of the premiums granted under these two headings is decided on the actual value of the additional work done.

Premiums to the officials of the headquarters management are granted according to the grades and independently of any condition to all officials attached to these managements, and finally supplements paid as indemnities to the staff who are in financial difficulties through no fault of their own and which are moreover distributed on a wide scale.

As a rule good services rendered to the administration form so many more titles to promotion, without prejudice to the conditions required by the regulations in force (such as examinations in particular cases). Apart from cases of exceptional capacity and merit, and on the free decision of the administration, nominations and promotions in all

posts can be made without it being necessary to observe the general rules.

In connection with the premiums for good work it may also be stated that the method of work having given excellent results from the economic point of view is the work by agreement worked to by the men in the main repair shops, in the depot shops or the permanent way shops, in the stores, etc., a third of the pay of the workmen of the Reichsbahn being covered by agreements.

2. — Czechoslovakia : State Railways.

This question has been dealt with on the occasion of the Madrid Congress (Report No. 3, Question XV, *Bulletin of the Railway Congress*, January 1930, pp. 236-239 and 253-257).

3. — Rumania : State Railways.

Special grants are suggested by the general manager and approved by the administrative council.

There are no premiums or grants for employees of the headquarters of the administration, nor are there any premiums common to the staff of all the services.

4. — Switzerland : Federal Railways.

Same reply as to Question No. 21.

5. — Poland : State Railways.

In all the services there are special grants — their importance varying according to the case — to recompense particular vigilance in the service, the spirit of self-denial, or successful initiative during accidents or other mishaps, etc.

6. — Bulgaria : State Railways and Harbours.

No reply to this question.

7. — Jugoslavia : State Railways.

No reply to this question.

8. — Sweden : Grängesberg-Oxelösund
Railways.

Same reply as to Question No. 27.

CHAPTER VIII.

**Participation of the staff in the general
results of the undertaking (participa-
tion of the staff in the profits).**

QUESTION No. 29. — *What steps have
been taken to interest the staff in the
general financial results of the under-
taking?*

*What are the methods of application
of the formula in use?*

*To what extent is the staff interested
in increasing the profits or receipts and
in reducing expenditure?*

*In what proportion is the pay of the
staff increased by this participation?*

Replies.

1. — Germany : German State Railway
Company.

Participation in the profits has not
been introduced by the Reichsbahn
which considers that a measure of this
kind would not influence in any way
the results nor the proper working of
the undertaking.

2. — Czechoslovakia : State Railways.

As regards the participation of the
staff in the general results of the under-
taking, the Czechoslovakian Railway
Administration is making provisional
tests in this direction, in certain sec-
tions of its services.

The report which follows is intended
to indicate certain principles which
have been used in applying the system
known as « à l'entreprise » (contract-
ing system) tried with success by the
State Railways, and to show the results
obtained.

Under this system the employees form
a sort of company, the object of which
is to produce profits; their activity is
limited solely to the working of the
undertaking and during the period of
their engagement, and is based on a con-
tract between them and the contractor
in which this period is laid down and
the obligations of the parties clearly
stipulated.

The undertaking includes several
« services », each with a number of
employees whose work is directed to
a common end. The services act like
independent contractors, having their
own balance sheets. The employees are
conscious of the contribution each
makes towards obtaining good final re-
sults, and know that every saving re-
presents a profit for the service of
which they are part and subsequently
for themselves. Besides sharing in the
profits they are also obliged to carry
the losses which can be attributed to
them, as well as those for which they
are not responsible.

The undertaking is obliged to esta-
blish double entry accounts.

This system is nothing but a method
designed to obtain more economical
operating in the interests of the three
parties concerned : the proprietor of the
undertaking, the employees and the
users.

From the fact that all the employees
of an undertaking are interested in its
proper working, any measure dealing
with the interests of several services can
only be taken after a conference be-
tween these services.

The accounts should be balanced as
often as possible, so as not to hold back
more than is necessary the share of pro-
fits due to the employees.

The share of the profits has to be
laid down in advance and be based on
the amount of work done by each em-
ployee, and at the same time take into
account the degree of responsibility of

his duties, his application, and the contribution he makes to the final results.

From the share of the profits due to each employee, either in whole or in part, the losses that he has caused the undertaking and for which he is responsible are deducted.

The advantages of the « contracting » system.

These advantages can be enumerated in the following order :

1) The participation in the profits and in the losses strengthens the bonds attaching the employee to the undertaking.

2) The work ceases to be onesided as the employee besides doing manual labour is obliged to use his brains in order to assure the undertaking working properly.

3) The system provides for the division and even the subdivision of the services, which can be nothing but a benefit for large undertakings, as it makes it possible to decentralise.

4) It suppresses most of the disputes between the employees and the contractors.

5) From the fact that all the employees of an undertaking collaborate to a common end, there is an automatic control of employee by employee, and of one service by another.

6) The « contracting » system is not likely to be applied unjustly, for the simple reason that the participation in the profits depends upon the proper working of the whole undertaking.

7) It makes it possible to improve the work done.

8) Seeing that the employees are guaranteed by contract 50 % or more of the profits, this arrangement must necessarily stimulate them to work.

9) The disadvantages of the employees in the services disappears with

this system under which the employees preoccupy themselves first of all with the interests of the undertaking and then with their own.

10) This system procures advantages to the employees in proportion to their deserts and is more equitable from the social point of view than other systems.

11) The characteristics of this « contracting » system, from whence flow in their turn the following advantages, are:

a) *its flexibility*, being adapted to all definite cases;

b) *its simplicity*, being readily understood by the employees and readily adapted, as it suppresses orders given by the contractor and implicitly the in submission of the employees to these orders.

c) *the suppression of the costly control over the service and the employees*, as a consequence of the automatic control set up between the employees and the services.

This system which was introduced during the course of the year 1931 in the stationary stores has given satisfactory results.

During the seven months (April to October 1931) the following results have been obtained:

The *purchasing service* has effected an average saving of 18.33 % on the prices laid down.

The *general charges* have diminished as the receipts of the stores increased.

The interest paid by the stores has been reduced in seven months by 38 %. Whereas in April 1931 the stores had to record a loss of 65 793.22 crowns, and in May a loss of 26 048.77 crowns, the following month it began to realise profits which in October 1931 reached the sum of 184 038.26 crowns.

As a consequence the following three facts were observed:

1) The stores was able to obtain results when above all it had greater

liberty of action, and when it was freed from the rigid prescriptions of the management, whence it appears that the «contracting» system tends to decentralisation.

2) The stores has not ceased to progress in a more and more marked way from month to month, which proves that the bases of the system are sound and that it is suitably applied.

3) The experience tried out has been quite successful if we refer to the good results obtained, and the system was put into practice without too great difficulties; it has also been noticed that the system of accounts has given excellent results.

* *

The favourable results obtained by introducing the «contracting» system at the stationary stores have decided the management of the Czechoslovakian Railways to introduce this system during the year 1932 to other services as well, such as: materials, maintenance, manufacture of tickets, and, if these trials give satisfactory results, the «contracting» system will be extended to all the services of the Railways.

3. — Rumania : State Railways.

The law on the Rumanian Railways makes provision for part (25 %) of the net profits of the undertaking to be distributed as a participation in the profits to the whole staff of the system, another part (0.25 %) to the administrative council, and the remainder, intended to feed reserve funds, the Public Treasury, etc.

Owing to the bad financial position to which the budgetary deficits are due, participation in the profits is for the time being inoperative.

4. — Switzerland : Federal Railways.

No reply to this question.

5. — Poland : State Railways.

The staff do not participate in the general results of the undertaking.

6. — Bulgaria : State Railways and Harbours.

No reply to this question.

7. — Yugoslavia : State Railways.

No reply to this question.

8. — Sweden : Grängesberg-Oxelösund Railways.

No reply to this question.

III. — Conclusions.

1. In view of the competition of the various other methods of transport with the railways, it is desirable that in each country the coordination of the methods of transport be taken in hand so that each of these may develop harmoniously without harm to the others. Special care should be taken that the extension of the competing methods of transport is not to the detriment of the railways, which through the influence they exercise on the most vital interests of the country and because of the large sums of capital invested in them, can justly be considered as the most important public service of the State.

2. The co-ordination of these undertakings appears to be most necessary in countries where there are several railway companies. In this case the ideal co-ordination would be amalgamation.

3. In the organisation of even one administration it is desirable to introduce the greatest simplification possible, and consequently to reduce the intermediate organisations interposed between the management and the executive.

The competence and the duties of each organisation should be clearly defined, so as to avoid conflicts between them. Extreme specialisation of the

staff is necessary to get the best quality of work. However, co-operation between the services and mutual aid either by special organisations, whose task is to harmonise and co-ordinate them, or by periodical conferences, or by both methods at the same time, is to be recommended from the economical point of view and after taking into account the fact that the needs of the different services vary irregularly even during the course of one and the same year.

It is to be hoped that the Railway Administrations will assist the efforts made by the International Organisations occupying themselves with the solution of the problem of the rational organisation of work, by communicating to these organisations the observations collected by them and by applying or carrying out tests of the methods proposed by these organisations.

4. It is desirable in view of the good results obtained that the standardisation of the rolling stock by reducing the number of types, and again, by standardising the parts and by drawing up tolerances according to which the parts should be either repaired to the given dimensions or replaced, should be applied on as wide a scale as possible.

It is also desirable that in the workshops, locomotive depots, etc., the most modern methods of work (belt system, etc.), should be introduced as far as possible.

5. As regards the staff, it is desirable that their health should be good, that they should be well instructed, capable of carrying out the duties required of them, and specialised as much as possible, for the good of the undertaking, besides being interested in the development thereof.

The staff, before engagement, should be subject to very careful selection, from the point of view of health, ability, and knowledge, in accordance with the regulations laid down.

The value of the psycho-technical examination may be stressed from this point of view.

Subsequently the men's general knowledge should be reviewed and completed by specialised training in professional schools which play a part of the greatest importance in the organisation of a railway administration; the good organisation and careful control of these schools is specially recommended.

The definite appointment of the staff after a period of practical experience and after having passed various examinations is also to be recommended.

As the number of men required by an administration varies during the course of the year and as complete balancing up cannot be obtained by the services helping one another reciprocally, it is desirable that an administration be able to count upon a nucleus of permanent staff which can be utilised as a whole even in the case of minimum traffic, and to meet the additional needs by means of temporary staff, which can be discharged when no longer needed.

6. It is desirable that the railway staff should be well paid, so that it has no need to earn other monies outside the railway, and so can devote the whole of its energy and ability to the administration.

In order that the staff should be interested in the proper working of the undertaking, it is desirable that part of the salaries should be fixed, this part being sufficient to live on, and that the remainder should be acquired in the form of premiums.

The proportion between the premiums and the fixed salary depends upon the nature of the work done, being greater in the case of the locomotive staff, the result of whose work is easier to ascertain, and proportionally smaller as the immediate result of the work is more difficult to calculate.

As the problem presents itself in the same way to all Administrations, it is

desirable that certain proportions between the premiums and the salaries be arrived at, which could be used as directives and be applied to all railways, with the greater reason that at the present time there is a very wide diversity of views on this point.

7. Besides the salary and the premiums, the staff enjoy certain advantages, among which travelling facilities over the railway may be mentioned as the most important.

From this point of view also there is a great diversity of practice from one country to another, and it is desirable that certain guiding principles be adopted.

8. It is advisable that the administrations should show the greatest interest in all that can maintain and improve the physical and moral health of the staff, in all that can improve the well-being of the staff, and in all that can remove their anxiety for the future, taking steps first of all to protect the staff from the dangers inherent in their trade.

The sporting and educational associations, such as the «Dopo Lavoro» are warmly to be recommended.

9. It is desirable that, by special publications, by professional schools, by instructors, and by guidance of all kinds, the sentiments of order, discipline, affection for the undertaking and for the country should be strengthened.

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION.

XIIth SESSION (CAIRO, 1933).

QUESTION IX:

Automatic train control and train stop. Track equipment. Locomotive fittings. Methods used for repeating signals on the locomotives. Devices intended to ensure the attention of the drivers.

REPORT No. 3

*(Belgium, Spain, France, Italy, Netherlands, Portugal and their Colonies;
Denmark, Finland, Luxemburg, Norway, Sweden and Switzerland),*

by V. VLAÏKOFF,

Signal Engineer, Bulgarian State Railways.

I. — Foreword.

The detailed questionnaire is divided into six chapters. The first chapter deals with general questions: types of equipment in use; list of the different systems, with the length in kilometres of the lines and the number of locomotives fitted; reply to the question as to whether it is a case of trial equipments or of permanent installations, with the year put into service; if experimental, to say if the expenditure was borne by the administration; attitude towards the automatic train control question; review of reasons why devices of this kind have not yet been used, and of the hypotheses under which trials of definite installations of this kind of equipment might be considered.

The second chapter deals with the object with which automatic train con-

trol is used, and the third with the method of working and the methods of construction of the arrangements used.

The fourth chapter deals with the results obtained in service in a general way and under unfavourable atmospheric conditions, the frequency of untimely action and of failure to act, the effect of these defects upon the service, and finally the improvements under consideration.

The fifth chapter deals with the question of cost, and the sixth with the future extension of automatic train control or similar devices.

This questionnaire was sent through the Secretariat of the International Railway Congress to the Railways of the following countries: Belgium, France, Holland, Italy, Portugal, Spain and their colonies, Denmark, Finland, Luxemburg,

Norway, Sweden and Switzerland; that is to say to 134 Railway Administrations in these countries. At least one Railway in each country replied to the questionnaire, but only 44 Railways answered in all, that is to say only about 33 %.

First of all in this report, we would like to thank the Engineers who have assisted in drawing up the replies. At the same time we would express our regret that many Railway Administrations who do not use, either experimentally or definitely equipment of this kind have not taken up any position in this matter. Part of the questions of the first chapter were drawn up with such Administrations in mind. We wished to ascertain from a consideration of many and varied points of view, the conditions that these devices are called upon to fill and the stage of evolution of the railway service at which they become useful and indispensable.

Among the 44 replies received, in 21 cases the Railway was satisfied with merely stating that devices of this kind were not used, and that consequently no fuller reply could be given to the questionnaire. Such Railways therefore have not taken up any definite position as regards this question. The following Administrations have made such a reply:

1. Norwegian State Railways.
2. Swedish State Railways.
3. Göteborg-Karlskrona Railway Company.
4. Bergslagen Railway Company.
5. Norsholm-Westervik-Hultsfred Railway Company.
6. Uppsala-Norrland Railway Company.
7. Dutch Indies Railway Company.
8. Belgian National Light Railway Company.
9. Lower Congo to Katanga Railway Company.
10. Upper Congo to the Great African Lakes.
11. Prince Henri Railway and Mining Company.

12. Société des Transports en commun de la région parisienne.

13. Djibouti to Addis-Abeba Railway Company.

14. Gafsa Railway Company (Tunisia).

15. Somain-Anzin and Belgian Frontier Railway Company.

16. Moroccan Railway Company.

17. Portuguese Beira-Alta Railway Company.

18. North of Spain Railways.

19. Lausanne-Ouchy Railway Company.

20. Nord-Milano Railway.

21. Ferrocarril Cantabrico.

It may be presumed that the administrations who did not send any reply have carried out no experiments with equipment of this kind.

The other replies can be divided into three groups:

1st group: replies from railway administrations not using such equipment, but who give reasons for their attitude at greater or less length;

2nd group: replies from railway administrations using only warning appliances or cab signals, with *a*) electro-mechanical transmission, *b*) inductive transmission, of the impulse from the track to the locomotive;

3rd group: replies from railway administrations using automatic train control with *a*) mechanical, *b*) electro-mechanical, *c*) inductive transmission of the impulse from the track to the locomotive.

II. — Replies of the 1st group of Administrations.

1. The *Finnish State Railways* give the following reasons why they have not adopted, even experimentally, devices of this kind:

«For the moment, neither the traffic nor the speed of our trains make it necessary to install such costly devices.

It also seems advisable to await a wider development of the different automatic train control systems.»

This administration therefore puts forward three reasons: service, financial reasons, and technical reasons.

2. The *Netherlands Railways* justify their attitude in a similar manner:

«We have no confidence in the certainty of functioning of the present devices, and for financial reasons we cannot consider the expenditure they entail. Moreover, in Holland, up to the present an accident due to signals being passed at danger has hardly ever occurred.»

The three following administrations give as their reason the small traffic on their railways:

3. *Reunion Railways and Harbours* (French Colony);

4. *Algerian Lines* of the French State;

5. *Tunisian Railway Company*.

6. The administration of the *Damas-Hamah Railways* (French Colony) points out on the other hand that the *speed of its trains is very low* and that consequently the conditions required to justify the adoption of equipment of this kind do not exist on its system.

7. The administration of the *Lourenço-Marques Harbours and Railways* (Portuguese Colony) stress especially the *small traffic* and the financial difficulties. It adds that the automatic block system will shortly be introduced on a line 90 km. (56 miles) long, having a traffic of about 1 000 000 tons annually.

8. The *Paris - Lyons - Mediterranean Company* (*Algerian Lines*) replies that it has no automatic train control equipment in use, but that the passenger locomotives, working both express and stopping trains, are fitted with *Flaman* speed recorders.

It adds that the number of trains is too small to justify the expenditure neces-

sary for the expensive automatic train control equipment and that it is not possible to think of carrying out any tests with arrangements of this kind until the traffic increases to a considerable extent.

9. The *French Est Railway*, being well satisfied with the apparatus fitted to its locomotives giving audible indication of signals at danger as well as recording them, does not feel called upon to undertake tests with devices which operate the brakes automatically when a signal at danger has been passed.

10. The *Danish State Railways* give the following reply to the questionnaire:

«On the Danish State Railways no kind of device is used automatically acting on the train when running. We have not experienced any need to adopt such devices. As we have recently introduced our visual system of signalling the safety of running trains appears to us to be safeguarded.»

11. This is also the opinion of the *Dutch East Indies State Railways*. They state that the safety of the service is guaranteed in a sufficient manner by the ordinary signalling methods, and this is the reason why no need has been experienced for undertaking automatic train control tests.

12. The *Madrid - Saragossa - Alicante Railways* give another reason: the efficacy of devices of this kind appears very problematic on trains not fitted with continuous brakes, such as mixed trains and goods trains. In addition the fitting of a certain number of locomotives with devices of this kind would involve heavy expenditure.

It is true that tests were made from May 1917 to February 1919 with an apparatus known as the signal warning devices, *Fournier-Testu* system, fitted on locomotive No. 116. The following reasons led to the tests being stopped:

a) The installation involved larger

compressed air pipes, with the result that the brake application was rough and jerky.

b) Vibrations of the train when running and small obstacles on the track frequently caused the premature action of the apparatus resulting in delays and upsetting the working.

The whole of the replies of this first group can therefore be reduced to the reasons mentioned in the beginning: service reasons, financial reasons, and technical reasons.

III. — Replies from the 2nd group of Administrations.

Cab signals.

A) With electro-mechanical transmission.

1. *French Nord Railway.* — On this Company's lines devices automatically applying the brakes have not been fitted.

From 1878 to 1896 this railway used an apparatus which was operated electrically when running over fixed contacts and acted on the brakes. In 1898 the control fittings on the locomotives were removed because they worked very irregularly. Since that time no devices of this kind have been used, and up to the present no new tests have been carried out, as the experiences of other railways have given rise to very strong criticisms, especially with regard to the premature, rough and hard brake action. When the installation of the automatic block system of signalling on the *French Nord Railway* is completed, the possibility of repeating on the locomotive the position of the distant signal and the home signal when at danger will be considered.

At the present time the locomotives are fitted with devices which give an audible warning in the driver's cab when a distant signal at danger has been passed. These devices are operated electrically by a fixed contact

placed in the four-foot. In addition each position of the signal (stop or pass) is noted on the speed recorder paper.

This system is in use on the whole of the 6 454 km. (4 010 miles) of track in service. The number of locomotives fitted is 2 371 and 95 are now being fitted. 4 972 fixed contact ramps called *crocodiles* are in use.

These appliances were already in use in 1872, but in their final form have only been used since 1927, being installed at the cost of the Company.

The contact ramp in the track consists of a hollow metal bar 2 m. (6 ft. 6 3/4 in.) long and 12 cm. (4 3/4 inches) wide, electrically insulated, placed 90 to 100 mm. (3 1/2 to 3 15/16 inches) above rail level, and 50 m. (164 feet) in front of the approach signal (fig. 1). In order that the contact may be good under all atmospheric conditions, the upper face of the bar is drilled with holes and paraffin is poured into the inside cavity, the evaporation preventing the formation of hoar frost and ice. A battery is fitted close to the signal and supplies continuous current at 10 to 15 volts. The battery is connected electrically to the contact-ramps, but between the two is inserted a switch which alternatively sends the positive and negative current to the contact ramp, according as the signal is on or off. In addition the switch is connected to the distant signal. In each case the free pole is earthed. When the contact is closed the return circuit is always through the track and the earth.

On the longitudinal centre line of the locomotive and 55 mm. (2 3/6 inches) above rail level, a brush is fastened which covers the contact ramp for a length of 35 mm. (1 3/8 inches) and makes contact with it by rubbing. The brush is connected electrically to two polarised electric magnets fitted to the Flaman speed recorder. Each magnet attracts an armature connected to a

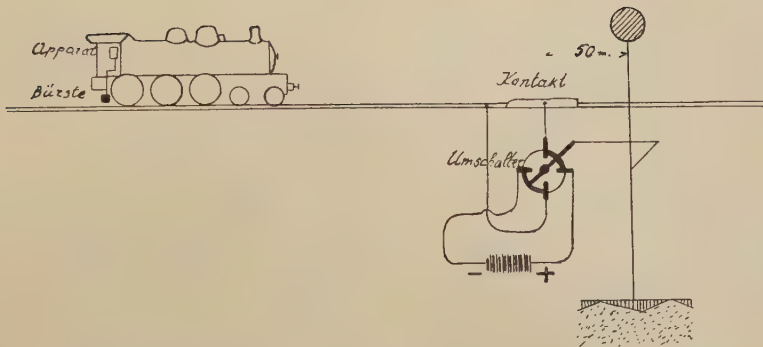


Fig. 1.

Explanation of German terms:

Apparat = Apparatus. — Bürste = Brush. — Kontakt = Contact. — Umschalter = Switch

spring acting against the magnet. By means of suitable levers the armatures act on one and the same pen.

According as to whether the positive or the negative current circulates through the windings of the electro-magnets one or other of these releases its armature and this latter under the action of the spring causes the pen to draw a vertical line on the *Flaman* recorder paper, from the middle towards the top if the distant signal is at danger (the contact ramp is then fed with positive current) and from the middle towards the base if the signal shows line clear (the contact ramp is fed with negative current). In addition, the armature of the positive electro-magnet, by means of a transmission, operates the whistle (the distant warning signal being at danger).

A second pen, the acknowledgment pen, is connected to a special lever which has to be operated whenever the driver observes in sufficient time a distant warning signal at danger. This lever at the same time prevents the whistle blowing. In this way each record of the stop signal should be limited by the line drawn by the acknowledgment pen, according as the lever is used: 1 for acknowledgment; 2 to stop the whistle.

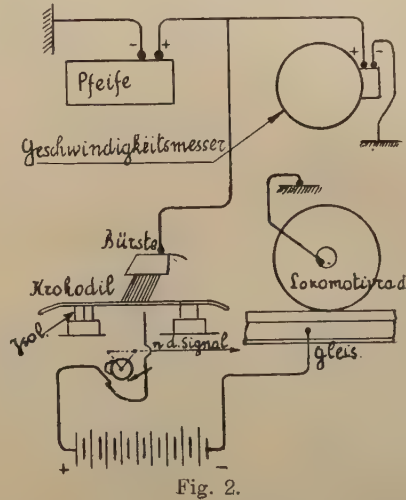


Fig. 2.

Explanation of German terms:

Bürste = Brush. — Gleis = Track. — Geschwindigkeitsmesser = Speed indicator. — Isol. = Insulation. — Krokodil = Ramp. — Lokomotivrad = Locomotive wheel. — N. d. Signal = To the signal. — Pfeife = Whistle.

The acknowledgment lever makes it possible to see at what distance the driver recognised the position of the distant signal. If the driver does not operate this lever, the whistle comes into action and continues to blow until the driver stops it by the lever. The whistle is worked by compressed air.

When this system is used on single lines, the contact ramp has to be lengthened by other ramps (called « basculeurs ») in order that the contact should only occur in the desired direction.

When the apparatus is damaged, the driver becomes aware of this by not hearing any whistle when running past a distant signal at danger.

The *Flaman* apparatus on the locomotive, completed by the *E. D. V.* apparatus costs 6 650 fr.; a contact ramp costs 2 800 fr.

Further improvements in this apparatus are constantly under consideration.

2. *Nord-Belge* Railway. — The apparatus employed by this company is the same as that briefly described under (1) of this chapter and the description need not therefore be repeated.

3. *French Midi* Railway. — The appliances that this company uses to call the attention of the driver to the site and position of certain signals are of the *Hausshaelter* system and analogous to those described under (1) of the present chapter. Unlike the latter, the *Hausshaelter* appliances only announce the stop position of the signals. Moreover, not only are the distant signals fitted with contacts but also a certain number of green and white discs and speed reduction signals are fitted. The same contacts are also placed on the outgoing roads at the locomotive sheds so that the apparatus on the locomotive can be tested before each journey.

The track equipment at each signal consists of the following elements :

A battery the negative pole of which is connected to one of the lines of rails; a fixed contact ramp called the « crocodile », which is placed on the centre line of the lines and parallel to the rails, in line with the signal, and which is insulated from the earth. An insulated conductor connects the contact ramp to a switch mounted on the signal. This switch is arranged to complete the

electrical connection between the contact ramp and the positive pole of the battery, but only when the signal is at danger.

A signal placed on the locomotive includes the following parts :

an electro-magnet in the *Hausshaelter* speed recorder. This electro-magnet operates, by the necessary auxiliary fittings, a valve which admits compressed air from the main reservoir to the whistle to operate it, and also a pen which marks on the diagram of the apparatus three points arranged in a triangle;

a metal contact brush, fixed on an insulated support under the back end of the locomotive;

an insulated conductor which connects the contact brush on one side to the electro-magnet, and the other to the mass of the locomotive and thereby to earth;

a control device hand-operated by pressing down a press button placed on the casing of the *Hausshaelter* apparatus. This button moves the pen and the position at which the three points are marked on the paper is consequently altered;

a connection giving communication between the main compressed air reservoir and the whistle.

If the signal is at danger and the contact brush of the locomotive in contact with the ramp on the track, the battery current passes through the switch to the contact brush. It passes through the electro-magnet and the appropriate devices open the valve to the whistle which then operates, and also moves the pen into contact with the diagram on which it marks three points. If the control press button is not pressed down soon enough the points are marked higher up. When the driver recognises the position of the signal and presses down the press button the points are marked lower down on the diagram and at the same time the diagram is prickmarked

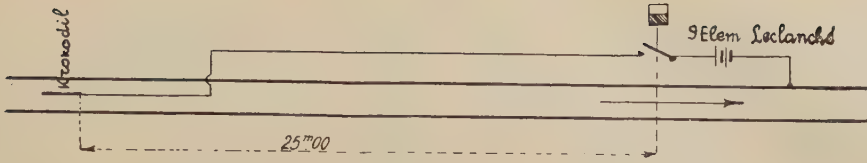


Fig. 3.

Note: 9 elem. Leclanché = 9 Leclanché cells.

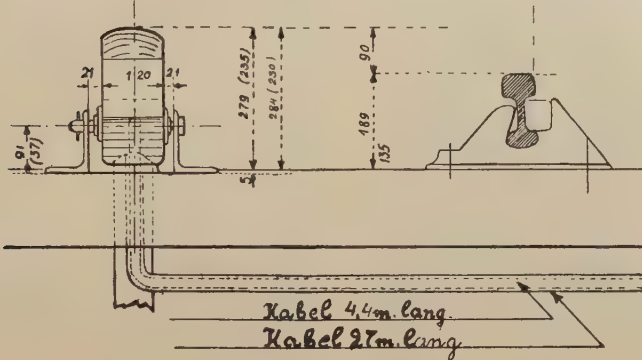


Fig. 4.

Note: Kabel... lang = Cable... long

below the triangle. After the locomotive has run a greater distance than that from which the signal can be sighted, the pen returns to its original position. The whistle is shut off by the upward movement of a slide valve in the base of the electro-magnet. Under the regulations of this railway, the drivers are not relieved of responsibility through this apparatus being fitted. On the contrary if this latter shows a signal is at danger, the driver must act accordingly whether the signal requires him to stop or indicates that the line is clear. Any failure of the apparatus should be noted in the control book and be reported at the first station to the stationmaster, and to the head guard.

4. *Paris-Orleans* Railways. — On the Paris-Orleans Railways, two systems intended to improve the safety of running trains are in use :

1) Apparatus repeating and recording the position of the home signal on the

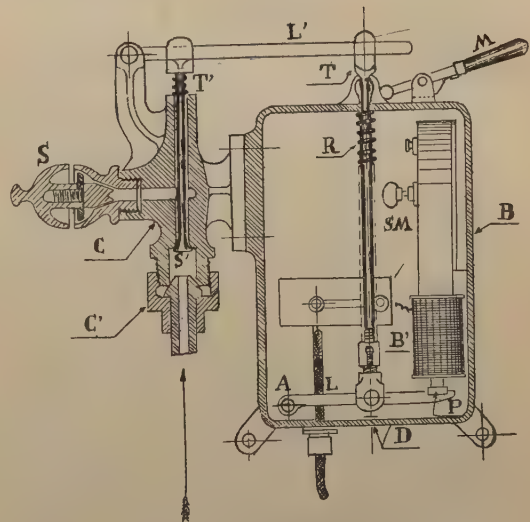


Fig. 5.

locomotive, fitted on 3776 km. (2 346 miles) of lines and on 1738 locomotives, 285 of which are electric;

2) The *Rodolausse* automatic train control system, installed on a 44-km. (27.3 miles) section and on 10 steam locomotives.

This latter system is dealt with in Chapter IV.

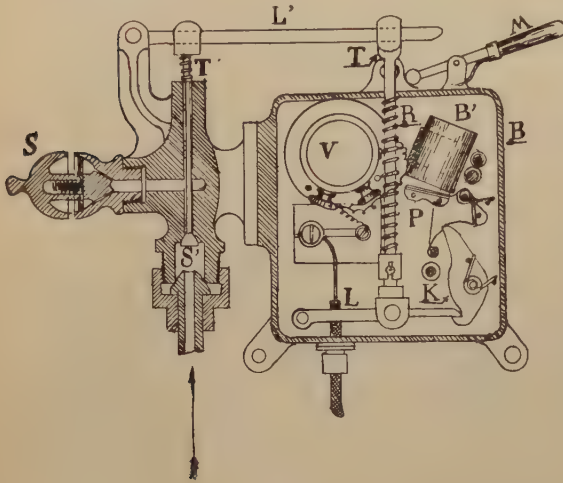


Fig. 6.

The appliances mentioned in the first place have been in use in their final form since 1922 and will be introduced by degrees over the whole railway.

The transmission of the track impulse to the locomotive is effected in the same manner as in the system described under (3) of the present chapter. Figure 2 shows the arrangement of the parts. The track contact consists of an insulated metal ramp 3.50 m. (11 feet 6 in.) long, fitted on the centre line of the track 25 m. (82 feet) in front of the signal (fig. 3). Contact ramps of the non-freezing type are mainly used. They are filled with paraffin to prevent the formation of hoar frost and ice. For some time contact ramps of the multiple narrow bar type have also been used and do not require filling with paraffin; they appear to give good results. The current is supplied by a battery of 8 to 15 volts tension, placed at the side of the

line. The top of the contact ramp is 90 mm. (3 1/2 inches) above the rail level (fig. 4). The battery is controlled by the switch placed in line with the signal.

The locomotive carries the contact brush and the apparatus electrically connected to it for audibly repeating the stop signal and for recording the passing of a distant signal at danger. The electro-automatic whistles are of two types: *Nord* (fig. 5) and *Mildé* (fig. 6).

The Nord type consists of a bronze whistle S which communicates with the compressed air reservoir through the valve S' operated by the spindle T'. The spindle T extends out of the box B and is connected on one side, by the lever L' to the spindle T', and on the other side, in the box itself to the lever L. A spring

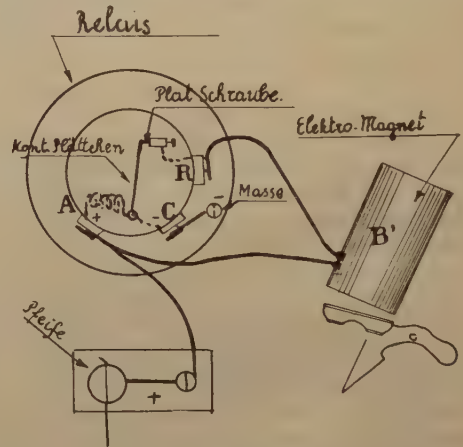


Fig. 7.

Note: Kont. Plättchen = Contact blade. — Plat. Schraube = Platinised screw. — Masse = Body (earth).

R pushes down the spindle. The lever L is attracted by the magnet P. In this way the spindle T is raised and the articulated spindle T' keeps the outlet from the valve closed. When a current of the desired polarity passes through the winding B' the lever L is released from the electro-magnet, the spindles T and T'

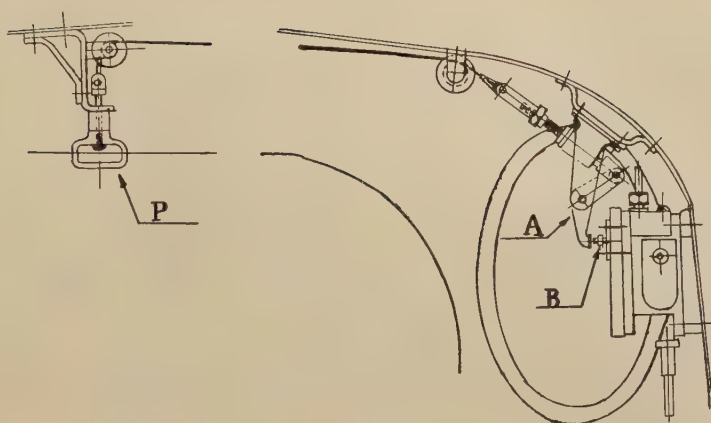


Fig. 8.

are driven down by the spring R, the valve opens and the whistle works until, through operating the handle M, the lever L is restored to its original position.

In the *Mildé* type, the lever L is connected by a system of ratchets to the electro-magnet B'. When the latter is fed with current it attracts the moveable armature P, the lever L rises, the whistle comes into action and continues to blow until the handle M is operated. The electro-automatic whistles should only function if the current passing through the electro-magnet is of the desired polarity. In order that this condition may be fulfilled a relay is fitted on the case of the apparatus, which will only pass current from the positive pole of the battery of the signal to be repeated. The essential feature of this relay (fig. 7) is a metal contact blade which can turn round a spindle and which is normally attracted by a permanent magnet (not shown in the design). Figure 7 shows the general arrangement.

The electric current from the positive terminal of the relay is divided into two circuits, the first of which passes by an electro-magnet and which attracts the contact blade, and then by the terminal C to earth. The second circuit passes

by the electro-magnet B', the platinised screw and the contact blade to earth.

The method of operation is the following :

a) When the contact brush is connected through the contact ramp to the positive pole of the battery, the current passes by the electro-magnet A which, by its magnetic action, attracts the contact blade and holds it against the platinised screw; in this way the circuit of the electro-magnet B' is completed and the whistle is operated.

b) When the contact brush is connected to the negative pole of the battery, the magnetic action of the electro-magnet is in opposition with the magnet and the contact between the blade and the platinised screw is broken. The whistle cannot then act seeing that the circuit of the electro-magnet B' is broken. The platinised screw and the contact blade which are the most sensitive organs of the apparatus are enclosed in a brass box. This is fitted on the outside with three insulated screws and the connection with the terminals can easily be made.

The recording device is fitted to the Hausschaelter speed recorder. It consists of a magnet which normally keeps its

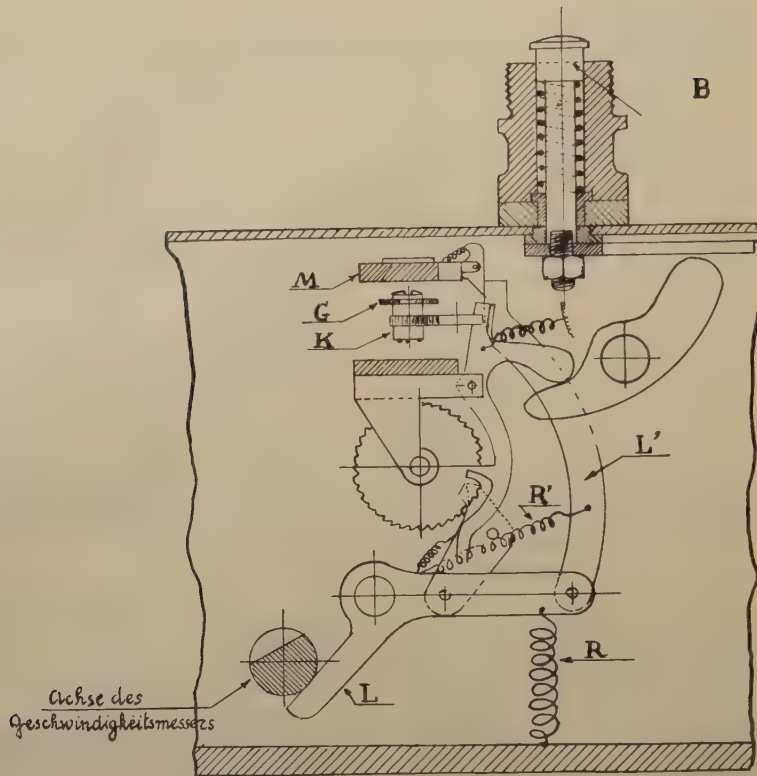


Fig. 9.

Note: Achse des Geschwindigkeitsmessers = Speed recorder centre line.

armature in the closed position. When the prescribed current passes through the windings, the armature falls and with it the hammer *M* (fig. 9) which strikes the punch *K*; this then punches three points in the form of an equilateral triangle through the paper band. The registering apparatus is completed by an acknowledgment lever (fig. 8). If the driver has perceived the signal at danger in sufficient time, he pulls the acknowledgment lever *P* or presses on the press button *B* if there is no lever. The punch then moves through an arc of 60° and the triangle is recorded with the base up. In addition a point is punched below the triangle if the

acknowledgment lever has been used at the proper moment; this point is displaced to the left if the lever is worked too soon and to the right if too late. The distance at which the lever should be operated can be registered on the apparatus. In this case it is set for 1 000 m. (3 280 feet). When the acknowledgment lever has been operated once, the punch returns to its initial position and cannot be operated a second time until after the signal has been passed.

Figure 10 shows 5 forms of record. No. 1 shows the triangle with the base up and the acknowledgment point below: the signal was at danger, the acknowledgment lever was operated at less than

1 000 m. (3 280 feet) before reaching the signal. No. 2 only shows the acknowledgment point; meanwhile the signal has been put to line clear. No 3 : the triangle is turned with the base downwards; the signal at danger was not noticed. No. 4 : the acknowledgment lever has been operated at more than 1 000 m. No 5 : the acknowledgment lever has been used too late.

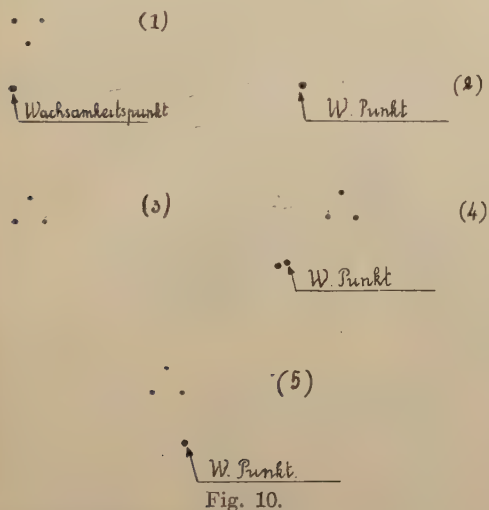


Fig. 10.

Wachsamkeitspunkt (W. Punkt) = Acknowledgment point.

Faults in the apparatus are not shown automatically and have to be found out. The apparatus is checked before leaving and again on arrival by passing over a control contact. The failures are in the proportion of about 1.5 %, but the equipment does not act untimely.

5. *French State Railways.* — The French State Railways have had in service, since 1923, some permanent installations by which the signal is repeated audibly and a record made on the paper band of the speed recorder when the driver passes a distant signal at danger. This equipment on the Augereau system is fitted on all locomotives.

The system is similar to those describ-

ed under (3) and (4) of the present chapter. The home signal is repeated by a compressed-air whistle. The recording is done on the *Flaman* system. Here again the driver is obliged to operate an acknowledgment lever and a record is made when he has recognised a signal at danger in sufficient time. Contrarily to the systems described above, the distance between the contact and the signal is only 15 m. (49 feet).

The possibility of also repeating signals indicating line clear in the cab, as well as of automatically applying the brakes, is being investigated.

6. *Paris - Lyons - Mediterranean Railways.* — The only apparatus in use by this Company has been fitted with the object of repeating and recording on the locomotives certain signals which have been run past at danger.

With the exception of shunting locomotives and some very old types, all the locomotives are fitted with these appliances at the present time, i. e. 4 673 engines out of 5 542. The length of line equipped with the corresponding track equipment is 6 744 km. (4 213 miles). These are permanent installations put down at the cost of the Company.

The drivers have to observe the signals as in the past; they are repeated simply to assist the driver when he has not noticed a signal. The location of the signals has not been modified in any way by these installations.

The track equipment is placed in most cases in line with the distant signals and only acts when these are at danger. When a home signal is run past a whistle begins to blow on the locomotive and at the same time a mark is made on the speed-recorder paper. If, on the contrary, the driver recognises a stop signal in sufficient time, he operates an acknowledgment lever and the record is made in a different way. This makes it possible to see afterwards if the driver has indeed paid attention to the signal

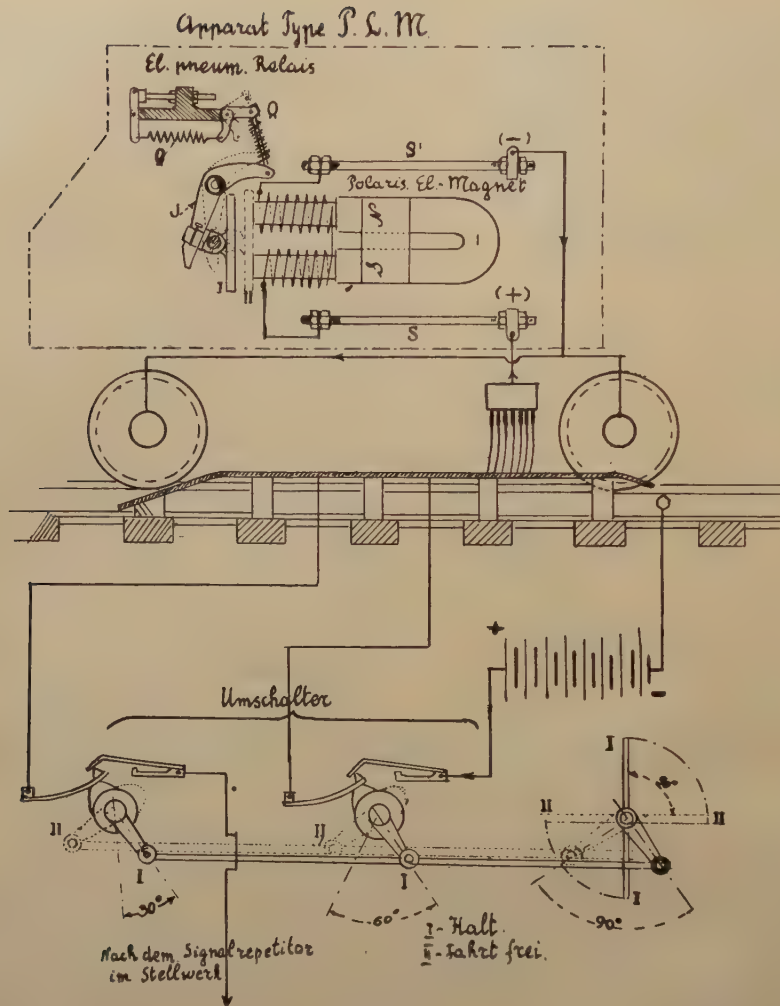


Fig. 11.

Explanation of German terms:

Apparat type P. L. M. = Paris-Lyons-Mediterranean type apparatus. — El. pneum. Relais = Electro-pneumatic relay. — Nach den Signalrepetitor im Stellwerk = To the signal repeater in the signal cabin. — Polaris el. magnet = Polarised electro-magnet. — Umschalter = Switch. — Halt = Stop. — Fahrt frei = Line clear.

and marked its position on the paper band before it was repeated.

Two types are in use : the *Paris-Lyons-Mediterranean* type and the modified *Est* type. The difference between these

two types is only a matter of detail; in principle the results obtained are the same.

The track equipment is the same for the two types. The contact ramps are

electrically insulated metal bars, 2.70 m. (8 ft. 10 in.) long for speeds up to 80 km. (50 miles) an hour and 4.20 m. (13 ft. 9 in.) for speeds over this. The control or test contact ramps are 1.90 m. (6 ft. 3 in.) long and are placed on the outgoing roads of the locomotive sheds. The batteries and switches on the signal are the same as those described above.

fails to act 1.98 times per 1 000 times signals are passed at danger.

7. Belgian National Railway Company.

— This railways use two cab signalling systems, the *Flaman* and the *Hasler*. 62 locomotives are fitted with the *Flaman* apparatus and run on the Brussels-Mons line, 61 km. (38 miles) long.

250 locomotives are fitted with the Hasler apparatus and run on the Brussels-Arlon line, 198 km. (123 miles) long. These permanent installations have been in use since 1930.

In addition 10 sets of automatic train control apparatus have been ordered but have not yet been delivered.

Both these two systems have been introduced with the object of repeating audibly, and of recording in the cab, distant signals at danger. They are intended simply to aid the driver who, as in the past must observe and obey the signals. He must not relax his vigilance in any case and he remains completely responsible.

Contact ramps similar to those described above are placed in line with all distant signals. They are of two types: the dry *Bauvais* on one line and the wet *Bauvais* on the other. The length of the contact ramps of both types is 3 m. (9 ft. 10 in.); their height above the rail level is 9 cm. (3 1/2 inches).

When a machine runs over the contact ramp at a distant signal at danger, the current passes by the contact brush to the locomotive apparatus, the cab whistle is blown and the danger position of the signal is recorded on the paper band of the speed recorder. The driver is expected to observe the home signal in sufficient time and to operate the acknowledgment lever, and that he has done so is recorded on the paper band by another sign. The action from the receiver on the locomotive to the whistle is transmitted electro-pneumatically. The whistle is operated by compressed air.

The fact that the apparatus is out of

Apparat Type Flaman E.

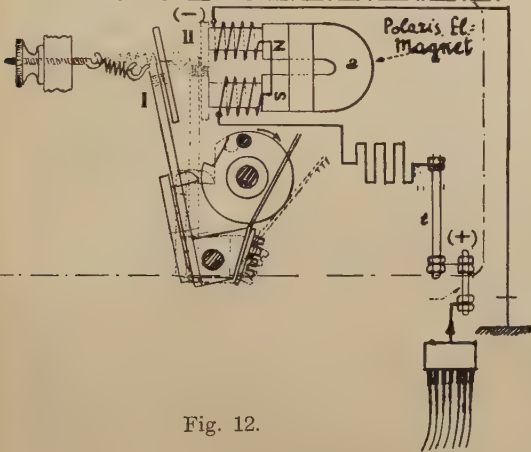


Fig. 12.

The contact brushes fitted on the locomotives are also the same for the two types. Each brush consists of 8 groups of ten flexible staggered metal blades, secured in a U shaped insulated clamp.

The design of the whistles is also the same for both types; they can be operated by compressed air or steam.

The principal difference is that in the *Paris-Lyons-Mediterranean* system the equipment is put into action through the polarised electro-magnet by means of an electro-pneumatic relay (fig. 11). In the *Est* type of the *Flaman* apparatus it is also done through the polarised electro-magnet (fig. 12), but by mechanical means.

When the signal is off no action occurs.

The figures show that the apparatus

order is not revealed automatically; it has to be ascertained and any defects have to be reported.

The resistance of the coils of the electro-magnet on the locomotive is 65 ohms and the electric current supply is 12 volts.

Insufficient experience is as yet available for it to be possible to decide with certainty if these appliances work uniformly and satisfactorily under unfavourable atmospheric conditions.

b) *Inductive transmission of the impulse.*

Italian State Railways. — Tests are about to be undertaken with the object of repeating audibly and visually and also recording in the driver's cab the location and the indication of the signals. The system in question has been designed by an engineer of the *Italian State Railways*. At the present time 30 locomotives and 218 km. (135 miles) of railway are being fitted with these appliances, at the cost of the administration. The appliances are only installed at distant signals. When this latter is at danger, an audible and visual signal is given in the driver's cab, at the same time as an audible warning is given to the train staff. The attention of the driver is checked by the fact that he is obliged to operate a special acknowledgment lever which marks the position of the signal on the paper band of the speed recorder.

The impulse is transmitted from the track to the locomotive by magnetic induction. Two sets of magneto inductive apparatus are placed in the six-foot and alongside the lines at the distant signal. When both of them transmit at the same time the impulse to the equipment on the locomotive passing over them, the visual signal which indicates that the line is clear is all that appears in the driver's cab. But when only one of the two acts (with the permanent magnet), the signals mentioned above are

given. Current at 24 volts and 0.8 amperes is supplied to the other induction apparatus only when the distant signal is off. The current is distributed by a switch mounted on the signal. The action of the home signal is covered in all cases by a third permanent magnet placed close to the first.

Two relays on the locomotive operated inductively by means of suitable equipment send compressed air to the cab signal, to the recorder and to the whistle for the train staff. The clearance between the fittings on the locomotive (fully loaded) and those of the track equipment is 130 mm. (5 1/8 inches) when running over the installation.

The system is suitable for all speeds, for steam and electric traction, and for both single and double-track lines.

The transmission of the action on the locomotive itself is effected electro-pneumatically. The whistle signal for the train staff can also be operated by steam.

When something is out of order, the stop signal is shown in the cab. The record is made on the paper of the speed recorder by perforating the paper.

It is not yet possible to give the actual results of these tests.

IV. — Replies from the 3rd group of railways.

Automatic train control.

a) *Mechanical transmission of the impulse.*

The appliances of the Rodolause system, described further on, were originally designed to transmit the impulse mechanically. Auxiliary devices to transmit it electro-mechanically have since been added in order to be able to use the existing track contact ramps and locomotive contact breshes.

The *French State Railways* have made tests with mechanical transmission. These tests however gave such bad results that this method of transmission has not been adopted nor the trials con-

tinued. Since that time electro-mechanical transmission is the only one tested and used.

Tests relative to the mechanical control of the Rodolausse apparatus have been carried out on the *Paris-Orleans* Railway. The track fitting consists of a metal stop, reversible in the direction of running, fixed alongside one of the rails and connected mechanically with the distant signal. If the latter is off, the stop is lowered in the direction of running. When, however the distant signal is on and the stop is struck by the receiving apparatus of the locomotive, it is knocked over and remains in this position until the whole of the train has passed it.

The receiving equipment on the locomotive consists of a flexible metal frame which turns about its centre. When it meets the track stop it is driven against a piston which pneumatically transmits the impulse to the locomotive apparatus and causes it to enter into action.

The receiver is fixed on the side of the front end of the locomotive, 295 mm. (11 5/8 inches) above the rail level; the track stop is 360 mm. (14 3/16 inches) above the rail level, and consequently there is an overlap of 65 mm. (2 9/16 inches).

b) *Electro-mechanical transmission* — of the impulse.

1. *Paris-Orleans Company.* — As we have mentioned in the preceding chapter, tests are being carried out on this railway with the Rodolausse apparatus. With this object, 10 locomotives running on the Paris to Limours and Sceaux-Robinson line have been equiped. The speed of the trains is limited to 70 km. (43.5 miles). The greater part of the cost has been borne by the railway.

The details of the transmission are the same as in the systems described in the preceding chapter. In the same way, the transmission details already fitted to

the speed recorders have been used again.

The apparatus placed on the locomotive occupies a space of $450 \times 450 \times 250$ mm. ($17 \frac{11}{16} \times 17 \frac{11}{16} \times 9 \frac{7}{8}$ inches) and weighs 35 kgr. (77 lb.); it includes the following parts (figs. 13 and 14).

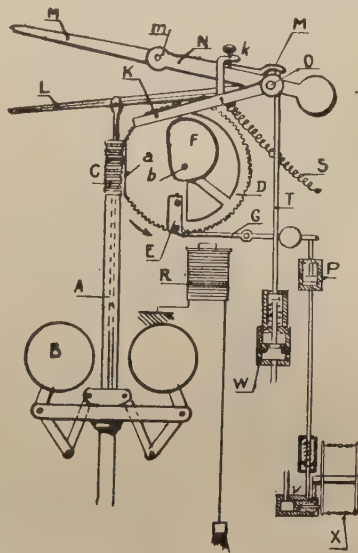


Fig. 13.

A pendulum B is mounted on a tube A; the frame of the pendulum is connected to a spindle which engages in the tube and drives the finger L of the speed indicator. The finger L oscillates about the centre O and moves over a sector graduated by tens of kilometres.

One end of the control finger M slides on the sector and the other extremity is connected to the spindle T which operates the valve. This finger M oscillates about the centre m carried by the counterbalance weighted lever N which oscillates about the fixed centre O. The lever K also moves about the centre O. The spring S holds the lever up to the mechanism F, carried by the toothed wheel D. This lever has an adjustable screw k

by which it is connected to the lever N so that this latter follows the movements of the lever K.

The toothed wheel D turns about the fixed centre *b*; a groove *a* keeps it clear of the worm screw C of the tube A. The toothed wheel is fitted with a counterweight, one half hollowed out, and the other solid. It has an escapement E against which butts the lever G; this latter is operated by the electric and pneumatic release gear R and P.

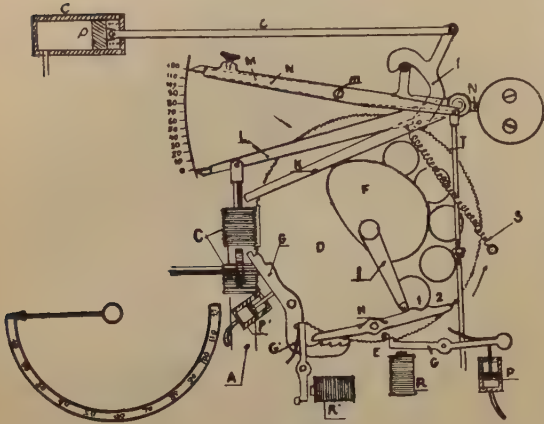


Fig. 14.

The valve W is connected to the train pipe; the opening is closed by a large flap. A small valve P, connected by the spindle T to the control finger is closed by a small flap which operates the large flap by means of a piston and thereby considerably reduces the action of the spindle T.

This apparatus makes it possible to produce the following effects :

1. Braking the train at the home signal by means of a contact ramp (or a mechanical stop on the track);
2. Reduction of the speed by means of two contact ramps, but in this case after running a given distance at the prescribed speed the apparatus returns

to its normal position and the speed of the train is no longer limited;

3. Limitation of the speed by means of a regulator mounted on the apparatus and operated by the driver. In this case the prescribed speed cannot be exceeded until the valve has been reset. When the signal is off, no action takes place. If on the other hand the signal indicates *stop* or *reduce speed* and if the driver has not noticed it, the brake is applied after a certain time, independently of the speed and the driver's attention is called by a whistle. Provided he takes certain steps the driver can then resume control of the train. If he continues to take no action, the braking continues as controlled by the apparatus, so that the train stops at the fixed point or until speed is sufficiently reduced. When a distant signal is on and between times the home signal is taken off, the brake is applied if the driver has not paid attention. If on the contrary he has been observant he can resume control of the train and continue to run without stopping.

Every action of the apparatus relating to the automatic control of the train is recorded on the paper band of the speed recorder.

When approaching a signal indicating *stop* or *reduction of speed*, the driver can stop all action by pressing in sufficient time the acknowledgment push button which causes a red signal to appear. If he omits to do so he can only resume charge of the train by accelerating the prescribed braking.

The impulse is transmitted on the locomotive electrically and pneumatically.

If the engine should pass a home signal, the lever G moves from the escapement E under the action of the electrical or mechanical impulse, the toothed wheel D is put into motion by the counterweight and the teeth engage with the worm C. At the same time that

the toothed wheel starts to move, the mechanism F, mounted excentrically, rises; the lever K is then lowered, the control finger M is moved to zero. The valve W is opened by the spindle T and the brake is applied. When the toothed wheel has made one turn and the groove again comes opposite the screw, the wheel is again pressed by the lever G against the escapement E.

In order to reduce the speed, the driver sets a lever to the figure on the frame corresponding to the desired speed. By means of a series of levers the position given to the lever M corresponds to this speed and at the same time records the operation on the paper band of the speed recorder. When the finger L bears on the control finger M, the valve W opens and the brake is applied.

In order to control the speed two sets of apparatus are installed in the track, the second at 25, 50 or 75 m. (82, 164 or 246 feet) from the first, according as the speed is to be limited to 30, 45 or 60 km. (18.6, 28 or 37 miles). After the second impulse, the lever G' is released. The lever H comes into engagement with one or other of the notches of lever G, according to the speed prescribed.

Defects in the apparatus are not automatically revealed. Test contacts are made to check the apparatus before starting, on arrival, and at certain selected points on the line.

The Rodolause apparatus is only used experimentally and has had to be altered several times. For speeds below 12 km. (7.5 miles) an hour, it gave very bad results. With higher speeds and when kept in good order, the proportion of failures was about 1.5 %. The apparatus automatically controls the train in a satisfactory way, but we would again repeat that the trials have only taken place up to a maximum speed of 70 km. (43.5 miles) an hour.

2, *French State Railways*. — Besides the tests and permanent installations

mentioned above, this administration has also made trials with the Regan apparatus which acts directly on the train brakes. The tests were made at the cost of the builder, in 1920, and the equipment was applied to one locomotive and two signals on the Paris to Dieppe line.

The track contact fitting consisted of a metal ramp about 30 m. (98 1/2 feet) long, electrically insulated and placed outside the track, the two ends of the ramp being slightly inclined. An electric current supplied by a battery controlled by a switch at the signal flowed through it. On the locomotive a metal wedge, free to move vertically, was fitted and worked a switch when it came into contact with the ramp. The electric current circulated through a relay and acted on the brakes by electric transmission. In addition the locomotive was fitted with a speed regulator, a switch, and a battery which cooperated so as to produce the following effects: 1. Braking of the train at a home signal; 2. Reduction of speed; 3. Braking of the train until the speed was reduced to that required by the signal.

These equipments were soon removed however because they were complicated, trains fitted with continuous brakes could not always be provided and also because of defects in the apparatus itself.

At the present time tests are being made with the Rodolause apparatus, but these tests have not yet been brought to any definite result. This equipment has been described in detail in the preceding paragraph.

c) *Inductive transmission of the impulse.*

1. *Swiss Federal Railways*. — On the Berne to Thoune line [31 km. (19.3 miles)] of the Swiss Federal Railways, seven stations and one locomotive have been equipped for trial purposes at the cost of the railway with track and locomotive magnets for the automatic control of the trains on the Signum Com-

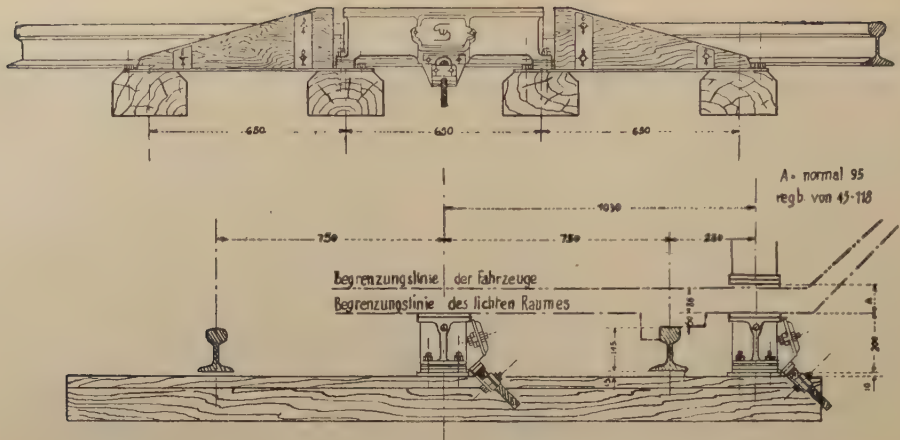


Fig. 15.

Begrenzungslinie der Fahrzeuge = Rolling stock gauge. -- Des lichten Raumes = Building gauge.

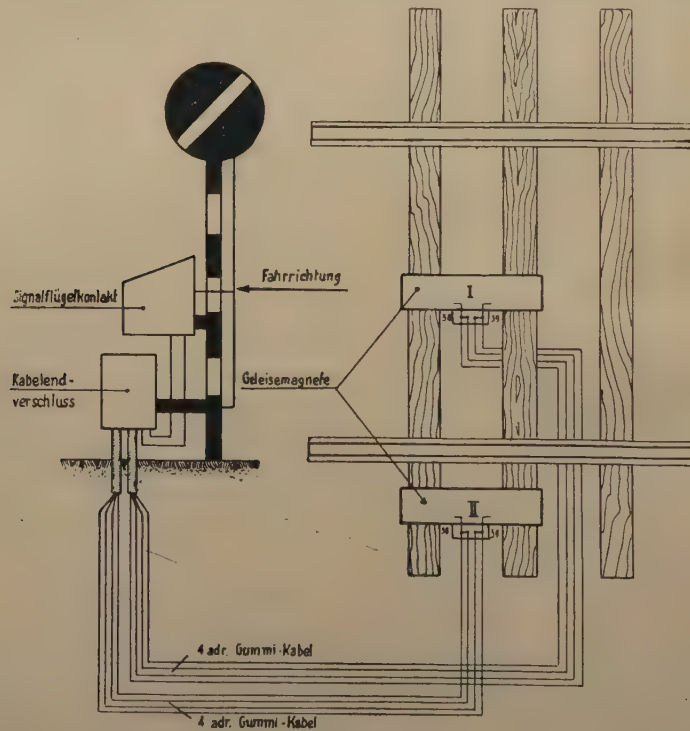
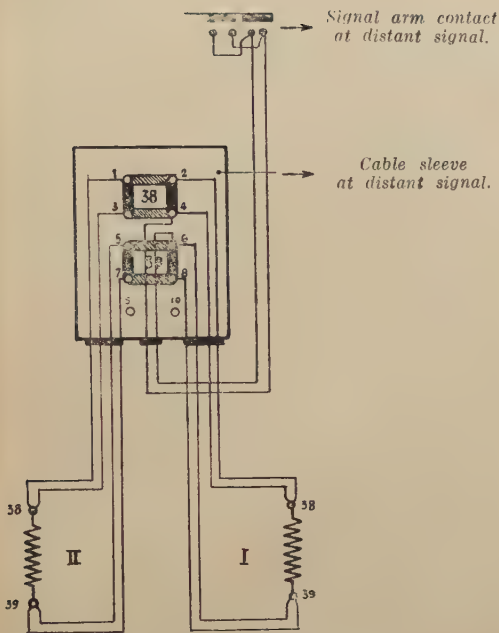


Fig. 16.

Explanation of German terms:

Fahrriichtung = Direction of running. -- Gleismagnete = Track magnets. -- Kabelendverschluss = Cable sleeve. -- Signalfügelkontakt = Signal arm contact. -- 4 adr. Gummi-Kabel = Four-wire rubber cable.



Track magnet II. Track magnet I.
Left hand. Right hand.
Seen in the direction of running.

Fig. 17.

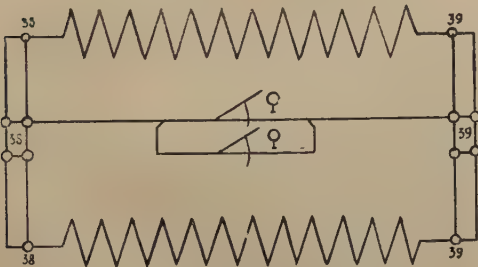


Fig. 18.

by the driver as in the past. It should serve as a supplementary means of protection when the driver has not observed or has not exactly recognised the position of the signals, or if he becomes ill. Automatic control is only applied to the distant signal. This latter is placed, without any alteration, at the distance the train can be stopped by the brakes in front of the home signal, which, when at danger, must not be passed. A second equipment, in line with the home signal for example, is not considered necessary because the driver will not pass the home signal at danger if he has recognised the distant signal indication and acted accordingly. This system is only fitted to the electric locomotives, but it can equally well be employed on steam locomotives. If need be, it can also be used to stop the train if the driver does not obey a signal indicating a given maximum speed; for the moment, however, this application has not been made.

In front of the distant signal two track magnets are placed between the lines and beside them, the position relatively to the loading gauge being indicated in figure 15. The magnets are connected to the distant signal by four-wire rubber cables (fig. 16). When the signal is off the windings of the track magnets are short-circuited and are inoperative (figs. 17 and 18). The track magnets are not fed by any supply of current.

The locomotive is also fitted with two magnets connected electrically to the corresponding appliances. The exciter circuit on the locomotive is fed by continuous current at 36 volts produced by a dynamo on the locomotive also supplying current for the control and lighting of the locomotive.

If a signal is at danger, the inductive action of the permanent track magnets on the locomotive magnets sets up an emission of current at the distant signal.

pany, of Wallisellen, system. Five other locomotives are being equipped. The tests have been in hand since 1927 and the tests installation has been in practical use since 1930.

The automatic control of the trains is not intended to replace the signals, which must be conscientiously observed

When the engine runs past the point at which the automatic control acts, an optical signal lights up (or according to the arrangement goes out) in the driver's cab; after running about 50 m. (164 feet) it is followed by an audible signal; 50 m. further on, the main switch is cut out and the automatic compressed air brake is brought into action. At the same time a long whistle warns the train staff. If the distant signal is off, no action takes place. The driver can cancel the effect of the automatic control of the train either in advance (on approaching the protected point), or afterwards (when noticing the optical or audible signal in the cab, or even after the commencement of the braking of the train). If the cancellation takes place after the braking has commenced, the driver can at once release the brakes before the train stops, or when the speed has been sufficiently reduced. Consequently when anything goes wrong with the signals, the train is not prevented from continuing its journey.

Each time the apparatus acts is recorded by means of the control marks on the speed recorder paper. The cancellation of the action by the driver can be registered in a similar way, but this has not been considered necessary at present. In order to avoid the cancellation of the automatic control of the train being abused, the key used for this purpose is fitted with a seal which is checked at regular intervals.

The condition of the automatic control apparatus is always visible in the driver's cab thanks to the use of a normally closed circuit. In addition its condition can be checked at any moment by means of a test press button. Furthermore, the driver is obliged to try the automatic control at the first distant signal he meets after midnight in the on position and to note the result of the test on a control sheet. It is also possible to carry out a test prior to leaving the shed by running past the special

equipment provided for the purpose, but this is not thought necessary for the moment. In the event of anything getting out of order the apparatus at once comes into action and steps have to be taken to cut it out.

The recorders are the recording speed indicators fitted to all the locomotives and are automatic, the action of the train control appliances being inscribed electrically. Up to the present the trial arrangements have shown themselves to be unaffected by atmospheric conditions. The trial period, however, is still too short for any definite statement to be made on the results. We may mention, however, that up to the present the system has always worked when a train has run past a distant signal at danger. In the beginning, the equipment sometimes acted prematurely as the result of violent vibration, but the action was cancelled out immediately by means of the acknowledgment press button and consequently did not give rise to any serious consequences. This defect has not occurred since the apparatus was improved. As regards the first cost and the cost of repairs no precise data can yet be supplied. Savings were not looked for, the system being intended to ensure increased safety.

After a fairly long and successful trial on the test section of the Swiss Federal Railways the extension of the tests to a greater length of line and finally the general adoption of the system are desirable.

2. The *Bernese Alps* Railway Company (Loetschberg-Simplon) have the same operating conditions as the Swiss Federal Railways and consequently the remarks made under section 1 of this chapter also apply to this railway.

V. — Final considerations.

We will begin by pointing out the very typical fact that out of 134 railway administrations only a small number have

carried out tests of automatic train control equipment, and not a single one has permanent installations in service. All the permanent installations mentioned in the replies are only recording and indicating apparatus, which exercise no action on the brakes of the train.

The first reason why no railway administration mentioned has permanent automatic train control installations is undoubtedly due to the imperfections in the appliances. It is known that the greatest difficulties are in the transmission of the impulse from the track to the locomotive. The transmission must be such that at least in theory it will never fail, as otherwise accidents might occur through the driver relying upon the control at the moment that it failed to work; it cannot be denied that all automatic systems act on the subconscious mind of the driver. If it were otherwise, no auxiliary devices to keep him on the alert or if need be to increase his attention would be employed. As soon as an impulse can be transmitted with reasonable certainty from the track to the locomotive, it will be possible to use it in various ingenious ways and for the most varied purposes.

The second reason, depending in part on the first, must be found in difficulties of a financial nature. These must not, however, be identified with the present general financial crisis. We would rather say that a justification has to be prepared for the cost which would appear to be very high. Undoubtedly there is hardly any railway administration who would base its action on this reason *alone*, as it is never possible to do too much to improve safety and the best is only just good enough. It would hardly be possible to want to effect savings by making a distinction between the accidents and by paying larger indemnities in the case of those due to running past home signals, thanks to not having taken certain means to avoid any such accidents should such means one day

exist in a perfect form. This would certainly be less costly than the general adoption of automatic train control but would not be justified vis-à-vis the public, for life and health are not easily evaluated and still less is it easy to compensate for them in money.

A third reason invoked against the adoption of automatic train control is of a character solely affecting the service: the small number of trains and their relatively low speed. Obviously the risk of passing a home signal increases with the density of traffic and its consequences are aggravated as the speed of the trains increases. On the other hand, the frequency of signals met on a line reacts unfavourably on the driver. The more signals there are, the more difficult it is for him to give the necessary attention and to recognise the signals without confusing them. As is well known, the driver has to do certain work when running. When the signals follow at short intervals, he has little time to carry out these other duties and consequently the presence of a signal may escape his attention, more so than when they are placed very far apart.

In spite of everything, it is undoubtedly true that from a certain stage in the evolution of railways, automatic train control must be considered as an indispensable safety factor. The constant improvement in the operation of the railways and of the measures of protection will as a consequence make it essential to check the good condition of the permanent way by means of track circuits, conjointly with automatic train control. But for the moment this question only affects some railway administrations. In the case of the others, and they are the majority, it is more important to close the weak point which lies in it: the possibility of running past a home signal at danger. First of all it is necessary to see if it would be possible to diminish the risk of running past the home signal by placing it from 230 to

300 m. (755 to 984 feet) in front of the turn-out or the danger point, and by improving the visibility of the signals by suitable measures, such as by installing clearly visible warning beams or posts in suitable positions, and also by supervising the way the signals are obeyed. In the same way the measures to be taken as regards the driver himself must not be neglected: particular care when selecting the men; sufficient standard of elementary education; assured position; raising the standard of the enginemens' work; rational arrangement of the turns of duty; particularly severe punishment for all infractions of the rules. These measures, however, have a limit which is traced by the speed and density of the trains on the one hand, and on the other by the frequency of the signals met on a line. Beyond this limit, auxiliary appliances must be provided in addition to help the driver to observe and obey the signal indication.

If we reflect that the following reasons have been urged against the adoption of automatic train control: the low speed and low density of trains, and the high cost of installation; and if we add thereto the frequency of the signals, neglecting on the other hand the technical imperfections, which it must be admitted will soon be removed, we can combine these factors into a formula which will enable us to decide when automatic train control can be used.

The automatic train control (C) is dependent upon the maximum speed (V) of the trains over a line, the number of pairs of trains (P) in 24 hours and the number of train protecting signals and home signals passed on the average in a distance of 10 km. (S). In addition the reduction of the expenditure exercises a favourable influence. In the formula we can put the cost of an equipment (K) as equal to the number of home signals that could be bought for the same amount of money.

The formula would then be approximately as follows:

$$C = \frac{V + P + S}{K} \geq X$$

X in this case would be the number that must be found empirically.

We would thus find for example that on a metropolitan railway where the trains run at a speed of 45 km. (28 miles) an hour, there would be much greater reason for automatic train control than on a main line, although over the latter the speed would be 90 km. (56 miles) an hour, because in the first case the pairs of trains are much more numerous and the signals follow one another at closer intervals. Actually automatic train control is widely used on the metropolitan railways.

Automatic train control on the main lines must fulfil two sets of conditions: first of all those concerning the transmission of the impulse from the track to the locomotive, and secondly those which the appliances on the locomotive must meet from the point of view of their speed of action.

The impulse ought to be transmitted each time, with the greatest possible degree of probability, in order that the apparatus on the locomotive always comes into action. It is necessary, therefore, that it should not be affected by atmospheric conditions; ballast and other obstacles on the track should not influence it; its connection with the signal should be carried out in a simple and reliable manner.

The apparatus on the locomotive should always function properly; it should be easy to see if it has done so, and to check the action at any time. If the apparatus should get out of order, this should not mean any danger as regards the service, but the defect should show itself immediately, for example by causing the apparatus to act. If it is remembered that the apparatus is only

required to act very rarely, according to calculations once for 5 to 7 million signals met, it is easy to realise that the above conditions must be filled absolutely.

Now these conditions can only be fulfilled with difficulty except by electrical means and with the appliances on the locomotive working on the principle of the normally closed circuit. With purely mechanical appliances or those working on the principle of the normally open circuit another consequence would be the constant attention, which either is not given or not in this way.

The principal drawback of the mechanical transmissions is not only the rapid wear of the brush but the particular difficulties of transmission in times of snow or frost, as at that time the whole of the appliance is covered with a coat of ice and cannot be moved. The same occurs in the case of the contact brushes of the electro-mechanical transmission which has been tested in regions where there are heavy falls of snow and great cold. In such weather an exceptionally rapid wear and deformation of these appliances is noticed and finally the metal brush is completely put out of use. In more temperate regions, with little snow and only moderate cold, the experiments made with mechanical and electro-mechanical transmission appear to have given more favourable results.

The best results have undoubtedly been obtained with the electro-inductive transmission of the impulse, even under unfavourable climatic conditions. This method of transmission also completely satisfies the desiderata mentioned above with regard to the automatic control of trains on main lines. Nonetheless many years of experience on a large scale are necessary before the suitability of this method of transmission can be definitely proved.

The favourable results which mechanical stops have given on metropolitan railways are wrongly expected on main

lines as well. The difference in the conditions — uniformity of the track and rolling stock on the former and the very great variation of all the elements on the second — is completely overlooked.

It may be concluded from the replies of the railway administrations consulted that the impulse given on the locomotive is principally utilised for the audible or visual indication of the position and indication of the distant signal and is only used in few cases for the automatic braking of the trains. The driver must, however, continue to observe the fixed signals and not in any case rely on the appliances; for this reason, special auxiliary equipment recording every failure on the part of the driver is fitted.

The question of knowing if the impulse should only be used to give an indication or in addition should apply the brakes has not yet, it would appear, been definitely solved. It appears, nonetheless, that indicating speed recorders are a welcomed addition, in some places pressed for, to the existing means of protection. The driver finds them an excellent help in his heavy duty. They can also be considered as a transition towards automatic train control. The appliances mentioned in chapter III must however be so improved that the proportion of failures does not exceed one in 5 000. The proportions given — 1 : 70 and 1 : 500 — should be considered as very high for systems of this kind. If we consider that the failures due to illness, weakness or death of the driver are only 1 : 10 000 000 it is evident that the proportion of 1 : 70 is very unfavourable.

The automatic braking of trains presents certain service drawbacks which can be made good by the appliances themselves. But the result is great complication, which is opposed to the principle of simplicity. In order to prevent unnecessary stops it should be possible to cancel out the braking; but on the other hand, it should not be possible for

it to be cancelled before the train is stopped at a signal at danger. On the other hand the different stopping distances of the trains cause difficulties from the point of view of the location of the automatic control equipment. All trains would not stop uniformly at the home signal, but sometimes would stop some distance away from it, and sometimes close to it. The result would be losses of time which ought to be entirely avoided.

In spite of everything, it must be presumed that the tests will make it possible to find a type of automatic train control meeting all desiderata. Nothing will then oppose the adoption, if the operating conditions lend themselves to it, of automatic train control as a permanent installation.

(The points submitted for discussion in Reports Nos. 1 and 2 also apply to the present Report.)

NEW BOOKS AND PUBLICATIONS.

[624. 02]

MENDIZABAL (Domingo), Ingeniero de Caminos. — **Estudio y Construcción de Estructuras Metalicas (Metal structures : Design and Construction)**. — One volume (10 1/4 × 7 1/2 inches) of 580 pages with numerous illustrations. — 1932, Madrid, Sucesores de Rivadeneyra (S. A.). — Editor: Artes Gráficas, Páseo de San Vicente, 20.

This book contains many interesting chapters.

The practical lines of calculation and building are well presented and can be read with interest even by the expert.

We may mention for example the whole chapter on riveting and joints, which is very fully developed and contains many examples of practical applications.

Particular mention must be made of a new departure for a book of this kind — a chapter entirely devoted to welding

— which makes it a very up-to-date work.

A large part of the book is devoted to metal construction, with certain examples — roofs of platforms, sheds, etc., — taken from railway working.

The chapter on bearings is likewise well treated and of great utility.

The work ends with considerations on the preservation of metal structures and on test apparatus.

We heartily recommend Mr. Mendizabal's book to our readers.

R. D.

[656. 212 (.5)]

Professor Dr. Ing. AMMANN (O.). — **Rangiertechnik (Technics of shunting yards)**. — One pamphlet (9 3/4 in. × 12 1/4 in.), 44 pages, with numerous illustrations and plates. Special issue of *Organ für die Fortschritte des Eisenbahnwesens*, 1930-1931. — 1931, Berlin, Published by Julius Springer, Linkstrasse, 23-24. (Price : 4.50 Rm.).

The technics of shunting yards have been considerably improved during recent years. The phenomenon, in principle quite simple, of the descent of a wagon over the slope of a shunting hump has been investigated much more closely. From the analysis of the various circumstances influencing the speed, the time and the length run, useful information concerning the best arrangement to be adopted, when designing not only the gravity humps but also the groups of sidings themselves to obtain the maximum capacity of shunting, has been obtained. The author develops the theoretical considerations upon which a study of this kind is based and supports them with practical data enabling the height

of the fall and the best profile to be fixed. He indicates the essential rules that must be observed when tracing the leading ends of the groups of sidings.

The shunting speed and the differences observed in the resistances of the vehicles make it necessary to use various methods of braking, at positions and in circumstances laid down. The author deals with this question of braking with the necessary theoretical developments; he indicates the essential factors, supported by drawings, of the most modern installations (automatic slipper brake, Thyssen brake, eddy-current brake, Hannauer brake). A discussion on the arrangements put forward to accelerate the speed of certain wagons ends

by considering them as methods only suitable for improving old yards.

The working of the points of the shunting yards presents certain particular features, which the author brings out by showing what conditions, from the theoretical and practical points of view, a centralised installation should fulfil to be satisfactory. He indicates the advantages of centralised electric points operating appliances automatically set by the wagons.

In other chapters the author describes the installations intended to replace economically the shunting locomotives (cable haulage, shunting lines on down gradients) and the means taken to back up wagons which ran short of their destination point.

At the end of the book will be found a design for a modern shunting yard, considered by the author as suitable for meeting the most usual cases.

E. M.

[656 .2]

HARE (T. Bernard), District Superintendent, London and North Eastern Railway. — **Practical Railway Operating.** 1 vol. (5 × 7 1/2 inches) of 163 pages with numerous tables and diagrams. 1932, London W. C. 2, Modern Transport Publishing Co. Ltd., Norman House, 105/109, Strand (Price : 5 sh. net).

This book completes the work by the same author entitled *British Railway Operation*. It is intended to illustrate by examples the principles previously laid down. The word *operating* should be understood as applying to the study of the movement of trains in stations and on the line with the intention of getting the maximum output from the equipment and the staff.

The author shows the influence upon the capacity of the lines of different factors, such as the speed of the trains, the different working speeds, and the signalling. By means of diagrams he studies how the service can be better organised in the passenger stations, in the goods yards, and in the shunting yards.

The passenger train service is considered from the point of view of the use made of the rolling stock and of the staff. The organisation of the goods trains raises general questions concerning the loads and speeds of the trains

and their interreactions. The author indicates a method of bringing out the original causes which upset the normal running of goods trains, and another based upon statistics of the movements of wagons, for investigating the best means of diagramming goods trains.

Among the other subjects dealt with we may mention : working of shunting engines, with a discussion on the power of such machines, rationalisation of coal export traffic, advantages to be obtained from the common user of private owners' wagons, control of the running of trains, what statistics relating to goods traffic should show and how they should be prepared.

These various questions are examined by dealing with concrete examples, with figures, and by reproductions of schemes, numerical tables, or graphs in the form the author considers the most suitable.

E. M.

[385.1 (.42)]

CAMPBELL (C. Douglas), M. A., Ph. D., Lecturer in Commerce in the University of Liverpool.—
British Railways in boom and depression. — 1 vol. (5 1/2 × 8 3/4 inches) of 125 pages.
 — 1932, London, P. S. King and Son, Ltd., Orchard House, Westminster. (Price : 6 sh.).

The author has set out to study the fluctuations in commerce and industry and their effects upon the traffic and receipts of the English Railways, during the period 1878 to 1930. It has been observed that the alternations of prosperity and depression in business generally follow clearly marked cycles, varying in amplitude, which react upon all industries and in particular upon the railway industry. The author by using modern statistical methods and data relating to the period considered has prepared statistical tables and traced diagrams which bring out this law of variation.

The particularly serious nature in England of the after-war crisis has made it necessary to divide the period considered into two parts, that of 1878 to 1912, and that of 1913 to 1930.

Chapters II and III deal in turn with these periods; that of 1878 to 1912 is characterised by a succession of four cycles, including in turn maximums of

prosperity and minimums of depression.

Chapter III analyses the after-war period; this latter is characterised, after a short period of exceptional prosperity (1919 to 1920) by an era of depression which has kept the volume of business at a level definitely below that of the pre-war period. The author analyses the causes of this crisis and its effects on the working of the railways.

In the first chapters the English railways are considered as a whole; in Chapter IV the author applies his method of analysis to the reactions produced by these fluctuations in business on the working of each of the four great Companies individually.

The last chapter deals with the law on rates of 1921 which provided for annual revisions of the rates based upon the earnings of the Companies during the last completed year; the author comments upon this law, examines its effects, and the criticisms to which it has given rise.

A. C.

[656.1 (.460) & 656.2 (.460)]

MADRID-SARAGOSSA-ALICANTE RAILWAY COMPANY. — **La coordinacion del transporte mecanico por carretera con el ferrocarril.** Comentarios al proyecto de ley sobre el servicio publico de transportes por carretera presentado a las Cortes constituyentes por el Ministro de Fomento en 6 de octubre de 1931. (**The coordination of mechanical transport by automobile and the railways.** Commentary on the projected law concerning public automobile road transport services, presented to the Cortès by the Minister of the Fomento, 6 October 1931). — One volume (10 × 7 inches), of 94 pages, with many tables and diagrams. Madrid; Published by the Madrid-Saragossa-Alicante Railway Company.

In Spain as in many other countries, road motor competition has considerably increased during the last ten years. Having many circumstances in its favour, it takes from the railways remunerative traffic and may upset the financial situation of enterprises in which considerable sums of capital are invested and the normal working of which is of

absolute necessity from the national point of view. The general opinion of well informed circles calls for reform and has found in Spain eloquent interpreters. The position is one which calls for the intervention of the public authorities and for alterations in the legislation.

The draft law presented to the Cortès

by the Minister of the Fomento on the 6 October 1931 tends to coordinate the two methods of transport in order to suppress undesirable competition and to diminish the inequality of the fiscal and other charges placed on the undertakings.

The investigation which the Madrid to Saragossa and Alicante Railway Company has published as a commentary on the projected law contains a detailed exposition as objective as possible of the situation of the companies vis-à-vis with the so far privileged methods of transport. After having shown the growing extent of automobile competition and stressing the necessity for coordination, it exposes, by means of statistical data, the inequality of the financial, legal and fiscal conditions applying to the undertakings. It then brings out the influence

of the present lack of order in road transport upon the railway traffic and upon the national financial position.

The authors during their report have aptly called attention to certain of the conclusions of the International Railway Congress of Madrid (May, 1930) and of the International Union of Railways (March, 1930). These conclusions are given *in extenso* in an appendix. Another appendix gives the text of the law passed in Germany on motor transport. Numerical tables make it possible to compare the actual burdens carried by road transport with those provided by the suggested law.

This investigation is a document of great value to have in the papers dealing with the question of the competition by road motor transport.

E. M.

[313. 385]

KELLERER (Hans) Studienassessor at Altötting (Bavaria). — **Mathematische Methoden in der Eisenbahnstatistik (Mathematical methods in railway statistics)**. — One vol. (8 1/4 in. × 5 3/4 in.) of 24 pages, with numerous tables and diagrams. — 1932, Munich, Graph. Kunstanstalt A. Huber, Publishers, Neuturmstrasse, 2a and 4.

Railway statistics contain numerical information in considerable quantity and of great diversity. These two circumstances explain why it is difficult to get them out on a scientific basis. The invention of perforated card machines which make it possible to class and totalise, according to different aspects, very large series of figures, has made it possible to throw light on important railway statistical questions having a close relationship with the accounting.

There are, however, many other problems that cannot be taken up except on the basis of mathematics and especially of the mathematical statistical method. The object of this work is to show, by putting forward certain of these problems, how the statistical questions of

railways can be treated from a mathematical point of view.

In the first chapter the author sets out the fundamental principles of the mathematical statistical method as applied to railways. In the second chapter he explains how it is possible rationally and with what calculated probability to elaborate the statistics by working with partial quantities. The third chapter shows the methods of getting out the coefficients of the concentration of traffic and the information that can be drawn from these coefficients. The fourth chapter deals with the methods of investigation of the variations which take place periodically or continually, or accidentally in the principal elements supplied by the domestic statistics of a railway.

E. M.

OFFICIAL INFORMATION

ISSUED BY THE

PERMANENT COMMISSION

OF THE

International Railway Congress Association.

Meeting of the Permanent Commission held on the 23 July 1932.

The Permanent Commission of the International Railway Congress Association met on the 23 July last at the Headquarters Offices of the Belgian National Railway Company, Mr. E. FOULON, being in the Chair.

* * *

The Meeting paid a tribute to the memory of Don Felix Boix, Managing Director of the North of Spain Railways and Member of the Permanent Commission, who passed away on the 11 May 1932.

The Meeting then appointed the following new Members of the Permanent Commission :

Mr. SEEFEHLNER, General Manager, Austrian Federal Railways,
and

Mr. de SAMARJAY, Secretary of State, President, General Management of the Royal Hungarian State Railways. (New mandates sanctioned by the Permanent Commission — Meeting held on the 5 May 1930.)

Furthermore,

Dr. FUKUKAWA, Secretary of the Japanese Ministry of Railways, and Manager of its Berlin Office,

Mr. JEZIEWSKI, Engineer, Ministerial Councillor, Ministry of Communications, Poland,

Mr. KNUTZEN, General Manager, Danish State Railways, and

Mr. José MORENO OSSORIO, Manager, North of Spain Railway Company,

were appointed members of the Permanent Commission in place of Messrs. YUMOTO, FRANK and ALSTRUP, who resigned as the result of a change in their official position, and of the late Mr. Boix.

On the other hand, on the proposal of the French Members of the Permanent Commission and as the result of a written vote taken in conformity with Art. 6 of the Rules and Regulations, Mr. PAUL, Honorary General Manager of the French Midi Railway Company, who retired from his position of Manager of the said Company, is maintained as a Member of the Permanent Commission until the Cairo Congress, in 1933.

The statement of receipts and expenses for the financial year 1931 was approved by the Meeting and an examination of the proposed budget for 1932 showed that the financial situation is satisfactory.

The rate of the variable part of the contribution, which had been increased to 20 gold-centimes for the financial year 1932, owing to the abandonment of the gold standard by the British Government and the effect of this decision on the assets of the Association (see *Bulletin*, January 1932) was reduced to 15 gold-centimes for 1933.

The Meeting was then acquainted with the latest arrangements in connection with the organisation of the 1933 Congress. The publication of the reports to be discussed at the Cairo Session is proceeding satisfactorily and it is expected that these documents will all be ready in good time for distribution to the Delegates from all countries, before their departure for Cairo.

Owing to local circumstances, the Congress will be held at *Heliopolis*, in the rooms of the *Heliopolis Palace*, which possesses all the accommodation necessary for the sectional and general meetings as well as for the various services of the Congress. The Meeting then examined the programme of the sectional and general meetings, drawn up by the Permanent Commission, and the programme of the receptions and excursions which will be organised by the Egyptian Local Commission.

The Meeting also reviewed the proposals made for the conveyance of Delegates and their family by the various Shipping Companies connecting the European ports of Marseilles, Genoa, etc. with Alexandria and Port Said, and it was found that the fare reductions offered are very substantial.

The Permanent Commission has received an invitation from the Suez Canal Company, and a trip to *Ismailia* will probably be arranged during the session.

The Meeting approved the composition of the Bureau of the 1933 Session and also took a decision, as a matter of principle, respecting the distribution of the mandates of the Presidents of the Sections, between the various Nations represented.

The Principal Sectional Secretaries and the Assistant General Secretaries were subsequently appointed.

Finally the Meeting nominated the Provisional Presidents whose task it will be to install the Bureaux of the sections and also the Special Reporters, who will summarise the various reports relative to one and the same question.

The Meeting was informed of the travelling facilities obtained by the Executive Committee from the principal Railway Administrations for the conveyance over their lines, of the Delegates proceeding to or returning from the Congress. Delegates and their family (wife and one unmarried daughter, or two unmarried daughters) are granted free travel and 30 kgr. (66 lb.) free luggage by the European Administrations and also those of Turkey (Asiatic lines), Syria and Palestine.

Furthermore the membership card which will be sent to the Delegates will also constitute a free pass on all the Egyptian Railways.

The memorandum, which will contain official information as regards the work of the Congress, the programme of the excursions and other points of interest, will also be sent to all the Delegates before their departure for Cairo and a complete list of the Members of the Congress will be handed to them when registering at Cairo.

Twenty-one Members of the Permanent

Commission are due to retire at the Cairo Session. They are reeligible and the candidates will be presented at the first Meeting to be held by the Commission at Cairo, 1933.

The principal Technical Journals and some Daily Newspapers will be invited to send a correspondent to the Cairo Session. The Egyptian Press will be invited by the Local Commission.

The Meeting examined and discussed a provisional Agenda for the XIIIth Congress, 1936. An amended list of questions will be sent to all the Members of the Permanent Commission before being submitted to the Sections at Cairo.

Some proposals to modify the periodicity of the Sessions were then presented to the Meeting. After discussion, the Members agreed to leave it to the Cairo Congress to decide when and where the XIIIth Session will take place. The Meeting, however, noted the invitation of the French Railways, to hold the XIIIth Session in Paris in September 1936.

A renewed invitation tending to hold the XIIIth Session at Tokyo will also be submitted to the Plenary Meeting of the Cairo Congress.

* * *

The following changes have taken place in the membership of the Association since the last Meeting.

A. — GOVERNMENTS.

The Governments of Austria and Hungary were elected members of the Association.

Finland and the Irish Free State altered the amount of their contribution.

Finally, the Governments of Nigeria, Gold Coast, South Australia and New South Wales resigned.

B. — ORGANISATIONS.

The International Company « Mitropa » (Sleeping and Restaurant Cars) have joined the Association.

The International Sleeping Car Company have altered the amount of their contribution.

C. — RAILWAY ADMINISTRATIONS.

Admissions :

	Km.	Miles.
Austrian Federal Railways.	5 871	3 654
Royal Hungarian State Railways	7 244	4 524
Bozanti - Alep - Nissibine Railway and Extensions.	886	550
South Eastern Railways of Italy (including the Sallentine Railway System).	475	295

Resignations :

Cordoba Central Railway.	1 950	1 212
Leopoldina Railway . . .	2 987	1 856
Sorocabana Railway . . .	2 165	1 345
Antofagasta (Chili) and Bolivia Railway.	1 318	819
Central of Georgia Ry. . .	3 076	1 911
Illinois Central System. . .	8 000	4 971
Norfolk and Western Ry.	3 607	2 241
Wabash Railway	4 064	2 525
Chauny to St. Gobain Ry.	15	9
Kent, Somerset, Shropshire and Welsh Light Railways Group.	228	142
Gold Coast Government Railways	803	499
Nigerian Railways	3 065	1 904
South Australian Government Railways	4 080	2 535
New South Wales Government Railways	9 253	5 749

Jamaica Government Ry.	337	209
Kristianstad - Hässleholm Railway	116	72

According to the explanations supplied by the Administrations concerned, these resignations were brought about by the world depression and the need for economies.

The Congress Association at the present time includes 221 Administrations operating a total length of 603 986 km. (375 306 miles). The number of the affiliated Organisations is now 11.

P. GHILAIN,
General Secretary.

E. FOULON.
President.

List of Members of the Permanent Commission

OF THE

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

(23 July 1932)

President :

E. **Foulon** ⁽¹⁾, directeur général de la Société Nationale des chemins de fer belges; rue du Progrès 74, Brussels;

Vice-Presidents :

C. **Colson** ⁽³⁾, membre de l'Institut, inspecteur général des ponts et chaussées, vice-président honoraire du Conseil d'Etat de France, membre du Conseil supérieur des chemins de fer de France; rue de Laplanche, 2, Paris;

U. **Lamalle** ⁽³⁾, directeur de l'exploitation à la Société Nationale des chemins de fer belges; rue de Louvain, 17, Brussels;

Members of the Executive Committee :

The Right Hon. Sir Evelyn **Cecil** ⁽²⁾, G. B. E., privy councillor, director, Southern Railway (Great Britain); Cadogan Square, 2, London, S. W. 1;

P. E. **Javary** ⁽²⁾, directeur de l'exploitation de la Compagnie du chemin de fer du Nord français; rue de Dunkerque, 18, Paris;

D. **Vickers** ⁽¹⁾, director, London Midland & Scottish Railway; Chapel House, Charles Street, Berkeley Square, London, W. 1.

Ex-presidents of sessions, members ex-officio :

The Right Hon. Viscount **Churchill**, G.C.V.O., chairman, Great Western Railway (Great Britain); Paddington Station, London, W. 2;

J. **Gaytán de Ayala**, ancien président du Conseil des travaux publics d'Espagne; Villa Ulialde, San Sebastian.

Members :

R. H. **Aishton** ⁽¹⁾, president, American Railway Association; 30, Vesey Street, New York;

W. W. **Atterbury** ⁽²⁾, president, Pennsylvania Railroad Company; Broad Street Station, Philadelphia, Pa.;

F. **Besser** ⁽²⁾, Ministerialrat, Reichsverkehrsministerium; Wilhelmstrasse, 80, Berlin, W. 8;

J. **Castiau** ⁽³⁾, secrétaire général du Ministère des Transports de Belgique; rue de la Charité, 25, Brussels;

H. **Caufriez** ⁽²⁾, directeur général de la Société Nationale belge des chemins de fer vicinaux; rue de la Science, 14, Brussels;

The Right Hon. Sir Evelyn **Cecil**, G. B. E., (already named);

H. E. **Chefik Pacha** ⁽³⁾, general manager, Egyptian State Railways; Cairo;

The Right Hon. Viscount **Churchill**, G.C.V.O., (already named);

P. A. **Clews** ⁽³⁾, European traffic manager, Canadian National Railways; 17-19, Cockspur Street, London S. W. 1;

C. **Colson** (already named);

R. **da Costa Couvereur** ⁽²⁾, ingénieur en chef de la division de la voie et des travaux de la Direction générale des chemins de fer, membre du Conseil supérieur des chemins de fer du Portugal; Bairro Sociaes, Arco de Cego, Rua A, No. 4, Lisbon;

Dautry ⁽¹⁾, directeur général des chemins de fer de l'Etat français; 20, rue de Rome, Paris;

(1) Retires at the 12th session.

(2) Retires at the 13th session.

(3) Retires at the 14th session.

- A. J. Day ⁽¹⁾, advisory engineer, Office of the High Commissioner for the Union of South Africa; South Africa House, 73, Strand, London W. C. 2;
- Sir Francis Dent ⁽¹⁾, C. V. O., director, Southern Railway (Great Britain); Dock House, Beaulieu (Hants), England;
- de Samarjay ⁽²⁾, secrétaire d'Etat, président de la Direction générale des Chemins de fer royaux de l'Etat hongrois; Andrássy ut, 73, Budapest VI;
- Dr. Dormmüller ⁽²⁾, Generaldirektor der Deutschen Reichsbahn-Gesellschaft; 35, Voss-Strasse, Berlin W. 8;
- F. Fiori ⁽²⁾, ingénieur, administrateur des chemins de fer de l'Etat italien; Villa Patrizi, Rome;
- M. Fontaneilles ⁽³⁾, inspecteur général des ponts et chaussées, président de la section des chemins de fer au Conseil général des ponts et chaussées de France, président du Conseil de réseau des chemins de fer d'Alsace et de Lorraine; rue de Sèvres, 4, Paris;
- E. Foulon (already named);
- Sir Henry Fowler ⁽³⁾, K. B. E., assistant to vice-president (research and development), London Midland & Scottish Railway; Derby;
- Dr. T. Fukukawa ⁽³⁾, secretary of the Japanese Ministry of Railways and manager of its Berlin Office; Friedrich Ebert-Strasse, 6, Berlin W. 8;
- J. Gaytán de Ayala (already named).
- P. Ghilain ⁽³⁾, ingénieur en chef au service du matériel de la Société Nationale des chemins de fer belges; rue du Progrès, 74, Brussels;
- A. Granholm ⁽³⁾, directeur général des chemins de fer de l'Etat suédois; Stockholm;
- H. N. Gresley ⁽³⁾, chief mechanical engineer, London & North Eastern Railway; King's Cross Station, London, N. 1;
- Grimpret ⁽³⁾, conseiller d'Etat, directeur général des chemins de fer au Ministère des Travaux publics de France; 244, boulevard St-Germain, Paris;
- R. J. Harvey ⁽¹⁾, consulting engineer to the Government of New-Zealand; Victoria Street, 34, Westminster, London, S. W. 1;
- Henry-Gréard ⁽¹⁾, directeur de la Compagnie du chemin de fer de Paris à Orléans; rue de Londres, 8, Paris;
- H. Hunziker ⁽²⁾, ingénieur, directeur de la division des chemins de fer du Département fédéral des postes et des chemins de fer suisses; Berne;
- Sir Cyril Hurcomb ⁽²⁾, K. B. E., C. B., secretary to the Ministry of Transport (Great-Britain); 6, Whitehall Gardens, London, S. W. 1;
- A. Jacques ⁽²⁾, directeur de la voie à la Société Nationale des chemins de fer belges; rue de Louvain, 17, Brussels;
- P. E. Javary (already named);
- H. Jezierski ⁽²⁾, conseiller ministériel au Ministère des Communications de Pologne; Warsaw;
- E. Kejr ⁽¹⁾, ingénieur, conseiller des constructions du département V/1 au Ministère des chemins de fer de Tchécoslovaquie; Prague;
- P. Knutzen ⁽¹⁾, directeur général des Chemins de fer de l'Etat danois; Sølvgade, 40, Copenhagen, K.
- U. Lamalle (already named);
- L. F. Loree ⁽¹⁾, president, Delaware & Hudson Railroad; Nassau Street, 32, New York City;
- Sir George McLaren Brown, K. B. E. ⁽³⁾, European general manager, Canadian Pacific Railway; 62, Charing Cross, London S. W. 1;
- A. Mange ⁽²⁾, administrateur de la Compagnie du chemin de fer de Paris à Orléans, président du Comité de gérance de l'Union internationale des chemins de fer; rue de la Bienfaisance, 42, Paris;
- C. Marchi ⁽²⁾, député au Parlement italien, président général de la Confederazione nazionale fascista dei trasporti terrestri e della navigazione interna; via Francesco Crispi, 10, Rome;

(1) Retires at the 12th session.

(2) Retires at the 13th session.

(3) Retires at the 14th session.

- M. **Margot** ⁽¹⁾, directeur général de la Compagnie des chemins de fer de Paris à Lyon et à la Méditerranée; rue Saint-Lazare, 88, Paris;
- A. **Marguerat** ⁽²⁾, directeur des Compagnies de chemins de fer de Viège à Zermatt, Furka-Oberalp, Gornergrat et Schöllenen; Lausanne;
- E. **Maristany** ⁽¹⁾, marquis d'Argentera, directeur général de la Compagnie des chemins de fer de Madrid à Saragosse et à Alicante; Estación de Atocha, Madrid;
- C. **Merentza** ⁽³⁾, sous-directeur général des Chemins de fer roumains; Bucarest;
- G. **Molle** ⁽²⁾, secrétaire technique à la Direction générale de la Société Nationale des chemins de fer belges; rue de Louvain, 17, Brussels;
- L. **Moralès** ⁽³⁾, vice-président du Conseil supérieur des chemins de fer d'Espagne, président du Conseil d'administration des chemins de fer de l'Ouest de l'Espagne, Estación de las Delicias, Madrid;
- J. **Moreno Ossorio** ⁽²⁾, directeur de la Compagnie des Chemins de fer du Nord de l'Espagne; Madrid;
- C. **Oddone** ⁽¹⁾, directeur général honoraire des Chemins de fer de l'Etat italien; Via Giacomo Carissimi, 33, Rome;
- Sir Frederic **Palmer** ⁽¹⁾, C. I. E., consulting engineer, Office of the High Commissioner for India; 55, Broadway, Westminster, London, S. W. 1;
- J. R. **Paul** ⁽¹⁾, directeur général honoraire de la Compagnie des chemins de fer du Midi français; boulevard Haussmann, 54, Paris (IX^e);
- G. **Philippe** ⁽¹⁾, inspecteur général des lignes Nord belges; Liège;
- P. **Riboud** ⁽³⁾, directeur de la Compagnie des chemins de fer de l'Est français; rue d'Alsace, 21, Paris;
- N. **Rulot** ⁽¹⁾, directeur du matériel de la Société Nationale des chemins de fer belges; 17, rue de Louvain, Brussels;
- A. **Schraif** ⁽³⁾, président de la Direction générale des chemins de fer fédéraux suisses; Berne;
- Dr.-Ing. **Seefehlner** ⁽³⁾, directeur général des chemins de fer fédéraux autrichiens; Schwarzenbergplatz, 3, Vienna;
- Sir Josiah **Stamp** ⁽³⁾, G. B. E., D. Sc., chairman and president of the Executive, London Midland & Scottish Railway; Euston Station, London N. W. 1;
- Sir Henry W. **Thornton** ⁽¹⁾, K. B. E., chairman and president, Canadian National Railways; Montreal, Que.;
- Antonio **Valenciano y Mazerès** ⁽³⁾, inspecteur général des ponts et chaussées, administrateur de la Compagnie des chemins de fer de Madrid à Saragosse et à Alicante; General Oráa, 5-3^o, Madrid;
- H. **van Manen** ⁽²⁾, directeur des chemins de fer néerlandais; Utrecht;
- Th. M. B. **van Marle** ⁽¹⁾, inspecteur général des chemins de fer et tramways néerlandais; Koningskade, 25, The Hague;
- L. **Velani** ⁽²⁾, directeur général des chemins de fer de l'Etat italien; Villa Patrizi, Rome;
- D. **Vickers** (already named);
- Sir Ralph Lewis **Wedgwood** ⁽²⁾, C. B., C. M. G., chief general manager, London & North Eastern Railway; King's Cross Station, London, N. 1;
- D. **Willard** ⁽²⁾, chairman of the Board, American Railway Association; president, Baltimore & Ohio Railroad; Baltimore, Md.;
- P. **Wolf** ⁽¹⁾, Geheimrat, Direktor der Deutschen Reichsbahn-Gesellschaft und Mitglied des Direktionsausschusses dieser Gesellschaft; Voss-Strasse, 35, Berlin, W. 8;

(1) Retires at the 12th session.

(2) Retires at the 13th session.

(3) Retires at the 14th session.

K. Y. **Woo** ⁽³⁾, director of the European Bureau of the Ministry of Railways of the National Government, Republic of China;
41, rue de Liège, Paris;

N ...⁽³⁾ (Argentina);

N ...⁽²⁾ (Australia);

N ...⁽²⁾ (Brazil);

N ...⁽³⁾ (Bulgaria);

N ...⁽³⁾ (Germany);

N ...⁽³⁾ (Germany);

N ...⁽¹⁾ (Germany);

N ...⁽³⁾ (Jugoslavia).

Honorary member :

Gustav **Behrens**, director, London Midland & Scottish Railway;
Chepstow Street, 20, Manchester.

SECRETARY'S OFFICE : rue du Progrès, 74, Brussels.

General secretary :

P. **Ghilain** (already named).

Assistant secretaries :

R. **Desprets**, ingénieur principal à la Société Nationale des Chemins de fer belges;

E. **Minsart**, ingénieur principal à la Société Nationale des Chemins de fer belges;

A. W. **Chantrell**, ingénieur principal à la Société Nationale des Chemins de fer belges.

Egyptian Section of the Permanent Commission.

(Executive Committee of the Local Organising Commission of the twelfth Session).

President :

H. E. **Chelik** Pacha, General Manager of the Egyptian State Railways (already named).

Members :

H. E. Joseph Aslan **Cattaui** Pacha, sénateur, ancien ministre;

Henri **Naus** Bey, directeur de la Société Générale des Sucreries et de la Raffinerie d'Egypte;

Mahmoud **Chaker** Bey, sous-secrétaire d'Etat au Ministère des Communications.

Secretaries :

Dr. I. **Levi**, ci-devant contrôleur de l'Administration de la Statistique;

Youssef Bey **Risgallah**, directeur général-adjoint des chemins de fer de l'Etat égyptien;

Fouad Bey **Hassib**, secrétaire général-adjoint de la présidence du Conseil des Ministres.

⁽¹⁾ Retires at the 12th session.

⁽²⁾ Retires at the 13th session.

⁽³⁾ Retires at the 14th session.